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## SURGICAL TREATMENT OF INSIDIOUS THROMBOSIS OF THE AORTA

FREDERICK W. COOPER JR., M.D., WILLIAM C. MCGARITY, M.D.

*Emory University, Ga.*

The surgical treatment of thrombosis of the aorta due to atherosclerosis was not reported in the American medical literature until 1946. A differentiation between the entities of embolic and thrombotic obliteration of the bifurcation of the aorta was described as early as 1814 by Graham.<sup>2</sup>

Barth<sup>1</sup> reported a case in 1848 in which a cylindrical thrombus developed and extended from the superior mesenteric artery to the aortic bifurcation with resulting symptoms of numbness and intermittent claudication in the lower extremities.

In 1898, Welch<sup>7</sup> collected a group of 14 patients who were considered to have thrombotic occlusion of the terminal aorta with 7 of these being primarily thrombotic. Leriche in 1923<sup>4</sup> again reported this lesion and in 1940<sup>5</sup> described a symptom complex and a diagnostic criteria with a report of 5 additional cases. Holden (1946)<sup>3</sup> reported 2 cases of thrombotic occlusion of the terminal aorta in which the patients were treated with sympathectomy with good results. Leriche (1948)<sup>6</sup> again published a classical description of the syndrome of insidious thrombosis of the terminal aorta and differentiating it from the occlusion of the terminal aorta by embolus.

### ETIOLOGY AND PATHOLOGY

Atheromatous plaques frequently develop in the terminal portion of the aorta and in the common iliac arteries. In this location ragged, calcified, ulcerated areas may occur in the intima, thus producing a point susceptible to gradual thrombosis. This condition has been observed by the authors in 41 patients. In 5 of these the symptoms were initially manifest in one lower extremity to be followed at a later date ranging from 3 to 15 years in the opposite

\* From the Department of Surgery, Emory University School of Medicine.

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lower extremity. In the remainder of the patients, the condition developed simultaneously affecting both lower extremities.

In these instances examination of the terminal aorta will reveal it to be filled with thrombus. The wall of the aorta is calcified and microscopic examination demonstrates marked intimal proliferation with large calcified plaques and with areas of degeneration of the media.

#### SYMPTOMATOLOGY

The most consistent symptom noticed by the patients were pains in the hips, thighs, and calves associated with walking. This pain was characteristic of intermittent claudication involving these muscles and immediately disappeared with the cessation of activity. Seventeen of the 41 patients also had some symptoms of paresthesias in the feet usually induced by exercise. Loss of the ability to maintain a sustained penile erection was also another common complaint.

The duration of symptoms ranged from 1 month to 15 years with an average duration of symptoms of 5 years.

Only 2 patients developed gangrene of one lower extremity in this series. Three additional patients had traumatic ulcerations of their feet which were failing to heal. Five additional patients showed minor trophic changes in the skin of the lower extremities due to ischemia.

#### DIAGNOSIS

A diagnosis is to be suspected when a patient complains of intermittent claudication in the hips and thighs as well as in the calf muscle. The femoral arterial pulsations are absent and no pulses can be felt below the aortic pulsations within the abdomen.

Pallor of the feet on elevation and rubor on dependency are usually present. Tropic changes in the skin and nails is unusual. It was present in only 5 of the patients in this series.

Differentiation from embolic occlusion of the terminal aorta is usually easily determined because of the greater rapidity with which the symptoms of embolic occlusion develop and progress.

Instrumental examination uniformly reveals a reduction in oscillometry at both the knee and ankle regions. Skin surface temperatures are not significantly reduced below normal in these patients.

The diagnosis can be confirmed by aortography, but these studies have not been routinely performed except upon a few of the patients.

#### PROGNOSIS

Prognosis has been quite variable in this series of patients. At the time of initial examination, 13 of the patients were found to have severe cardiac or cerebral disease which was of far greater significance than their arterial insufficiency to their lower extremities. One patient who had had symptoms for 10 years, died 2 months following bilateral lumbar sympathectomies from a coronary thrombosis or pulmonary embolus. One patient who had had symptoms for 10 months at the time of the initial examination died 17 months following

bilateral lumbar sympathectomies. This patient had a hypercholesterolemia with generalized atherosclerosis and with eventual multiple sites of arterial obliteration. No correlation could be made between duration of symptoms and the eventual prognosis. Frequently, patients with the shortest history of disease showed evidences of the most rapid progression. The ensuing complications were due to generalized atherosclerotic disease throughout the body, but particularly involving the coronary vessels as well as the kidneys, and the cerebral vessels.

#### TREATMENT

Seventeen of the 41 patients have been operated upon for this disease. The remaining patients were not operated upon either because their generalized disease was so severe as to contraindicate operation or the patients thought their symptoms were not sufficiently severe to warrant any procedures.

Fifteen of these patients were subjected to bilateral lumbar sympathectomies. Two patients were operated upon with resection of the terminal aorta and replacement with an aortic graft.

Leriche has recommended that sympathectomy to remove the vasoconstricting nerve supply to the collateral pathways below the area and to the arterial trunks below the obliterated bifurcation. Leriche (1948) also suggested resection of the bifurcation of the aorta and the thrombosed area. He believed that this performed a twofold purpose, permitting removal of the thrombus and preventing continuation of its formation proximally. This was done in one of our patients without replacement with an arterial graft. Leriche stated that it removed an area of irritation which is a site for excitatory vasoconstrictor impulses producing vasospasms in the peripheral channels. At the time, however, he suggested that the ideal treatment is replacement of the resected segment of aorta with a graft.

#### END RESULTS

In the 15 patients undergoing lumbar sympathectomy alone, the results have been good in 13 patients. While their tolerance for activity has not been returned to normal it has been sufficiently increased so that it is not incapacitating. Similarly, paresthesias have disappeared in this group. Two patients who have had their aortas replaced with an aortic graft and who also had bilateral lumbar sympathectomies have continued to have good femoral arterial pulsations. Both patients however, have had a continuation of their atherosclerotic disease in their more distal arterial tree, and while improved, their functional tolerance is still diminished, and their symptoms of intermittent claudication have been only moderately improved. In the additional group of patients who did not believe that their symptoms were not sufficiently severe to justify surgery, in the majority their symptoms have remained stationary or have been only slowly progressively increasing.

#### SUMMARY AND CONCLUSIONS

The cases of 41 patients with insidious thrombosis of the terminal aorta are reported.

Symptoms developed initially in one lower extremity in 5 of the patients with symptoms developing in the opposite extremity at a later date ranging from 3 to 15 years.

Severe cardiovascular disease involving sites other than the terminal aorta was present in 13 patients when initially examined.

Only 17 of the 41 patients have been operated upon for this condition. Operation was not advised in certain instances because of severe cardiovascular disease elsewhere and in the remaining group the patients did not believe that their symptoms were sufficiently severe to justify surgical intervention.

The operation upon 15 patients consisted only of bilateral lumbar sympathectomies. Two patients were operated upon with resection of the terminal aorta and the insertion of an aortic homograft.

*Dept. of Surgery*  
*Emory University*  
*School of Medicine*  
*Emory University, Ga.*

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## TREATMENT OF PANCREATITIS BY SPHINCTEROTOMY

HENRY DOUBILET, M.D.

*New York City*

Since pancreatitis, as other diseases such as duodenal ulcer, results from functional disorders, the fundamental treatment should be essentially medical. However the anatomic and physiologic factors present in the pancreas create a situation which not only may lead to the gradual destruction of the organ with repeated attacks but may even result in death.

Early mild attacks of pancreatitis can be treated medically. A severe attack should always be treated by placing the pancreas and its associated organs completely at rest. This is achieved by nasogastric suction, administration of anticholinergic drugs, and by active and adequate replacement of electrolytes, water, and plasma in the form of serum albumin.

Persistent recurrent uncontrollable attacks should be treated properly by surgical means.

Treatment must be based on a knowledge of the etiology and pathology of the disease. It is our belief that pancreatitis results basically from the reflux of bile into the pancreatic ducts. Such a concept must be based on three premises: (1) that the bile and pancreatic ducts join above the papilla of Vater; (2) that increased tonicity of the sphincter of Oddi converts these ducts into a common passageway, allowing bile to be retrojected into the pancreatic duct; and (3) that section of the sphincter of Oddi, by preventing further entry of bile into the pancreatic duct, will halt the progress of the disease.<sup>2, 3</sup>

Based on an experience of 500 cases we can report:

1. A common passageway is always present in recurrent pancreatitis (fig. 1).
2. Spasm of the human sphincter of Oddi results from emotional disturbances, exhaustion, or as a reflex to pain produced by stones in the gallbladder or biliary tract.
3. That sphincterotomy is effective in that:
  - (a) Pain due to distention of bile and pancreatic ducts behind the spastic sphincter is abolished.
  - (b) Attacks of severe pain due to recurrent acute inflammation of the pancreas resulting from reflux of bile also disappears.
  - (c) Progress of the disease is arrested and the pancreas is given an opportunity to regenerate within the limits of the fibrosed capsule that encloses it. Serial secretin tests show that such regeneration occurs in many patients, and in some histologic evidence supports this finding of functional recovery.

From the Department of Surgery, New York University College of Medicine, and the Third (New York University) Surgical Division, Bellevue Hospital.

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FIG. 1. *Operative cholangiogram.* While the radiopaque solution is being injected through the cystic duct hydrochloric acid (N/10) is applied to the papilla through a Rehfus tube. This produces spasm of the sphincter of Oddi and allows reflux to occur, visualizing the whole pancreatic duct as far as the tail (arrow).

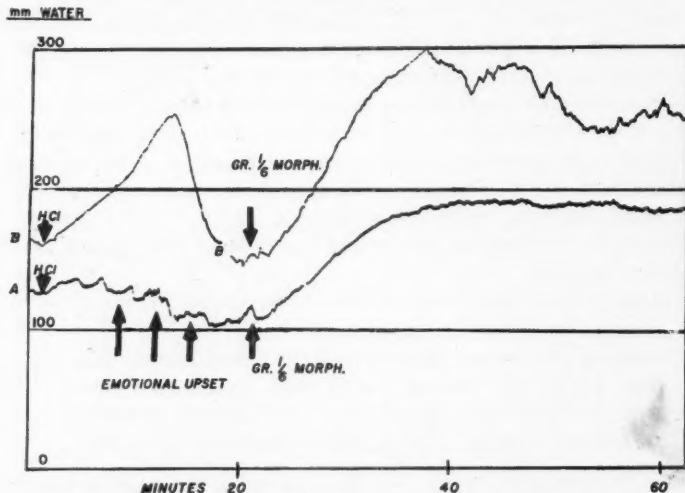


FIG. 2. *Effect of sphincterotomy.* Abolition of the function of the sphincter of Oddi is demonstrated by these superimposed kymographic records. Normally (B) acid and morphine produce spasm of the sphincter of Oddi. After sphincterotomy (A) neither hydrochloric acid nor an emotional upset have any effect in increasing the resistance to flow of bile into the duodenum. Morphine does increase the resistance but that action is due solely to the duodenal wall. This observation is important because it demonstrates that the duodenal wall, which acts as a pinch-cock, was not affected by the sphincterotomy.

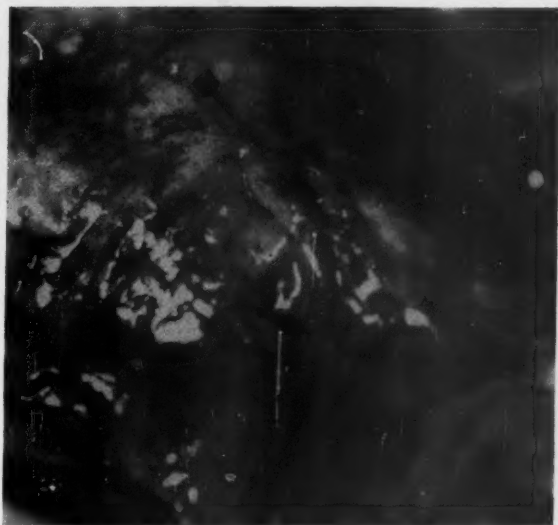


FIG. 3. Photograph of sectioned sphincter of Oddi 4 years after sphincterotomy. The ampulla lies wide open (arrow). The plica longitudinalis descending from the site of the original papilla can be seen (2 arrows).

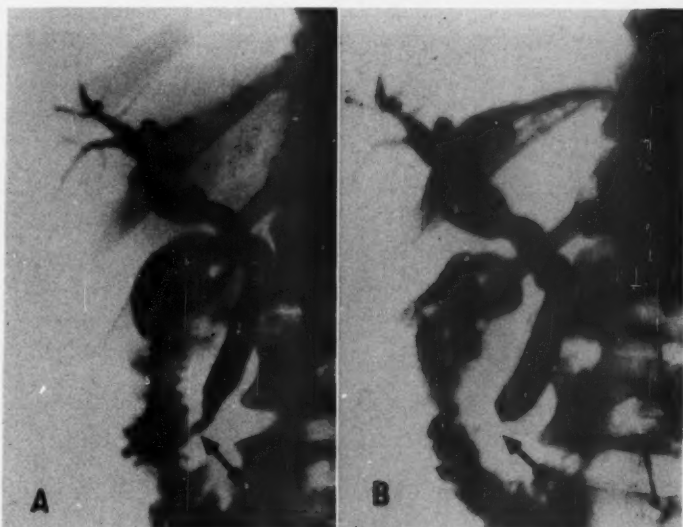


FIG. 4. Prevention of duodenal reflux after sphincterotomy. After sphincterotomy the duodenal wall is anatomically and physiologically intact. A cholangiogram (A) 4 weeks after sphincterotomy shows ready entrance of dye into the duodenum (arrow). Five minutes after the administration of morphine (B) note compression (arrow) of the intramural part of the common duct by the duodenal wall.

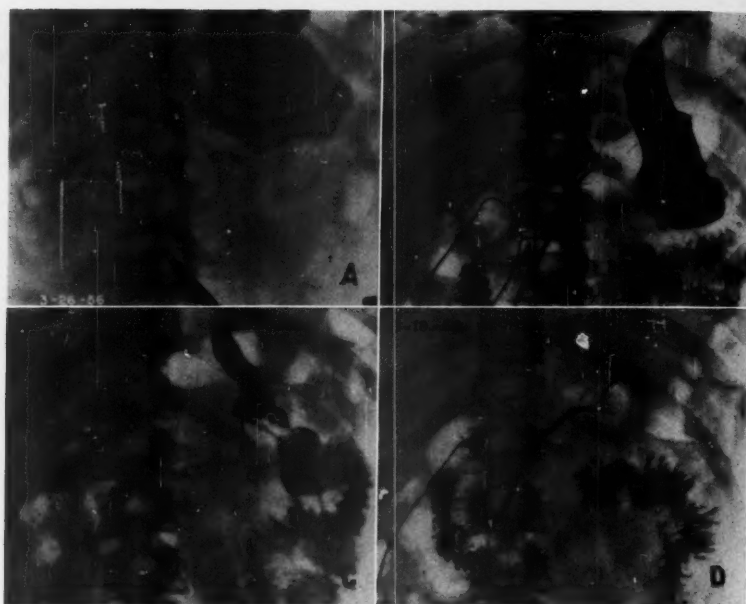


FIG. 5. Treatment of pancreatic pseudocyst by sphincterotomy. Operative pancreatogram (A) through tube lying in pancreatic duct (arrow) revealed an enormous pseudocyst. By reducing the pancreatic intraductal pressure the pseudocyst decreased rapidly in size. Serial pancreatograms demonstrated that it was about one-fourth the original size 25 days after operation (B), one-tenth the original size 40 days after operation (C) and had disappeared completely 54 days after operation (D).



FIG. 6. Treatment of pancreatic fistula resulting from drainage of pancreatic pseudocyst. Operative cholangiogram revealed reflux into the pancreatic duct to the tail as a result of spasm of the sphincter of Oddi (arrow). Note that the pancreatic duct crossed the tube lying in the pancreatic fistula near the tail of the pancreas. Reduction in pancreatic intraductal pressure lead to the closure of the pancreatic fistula in a few days.

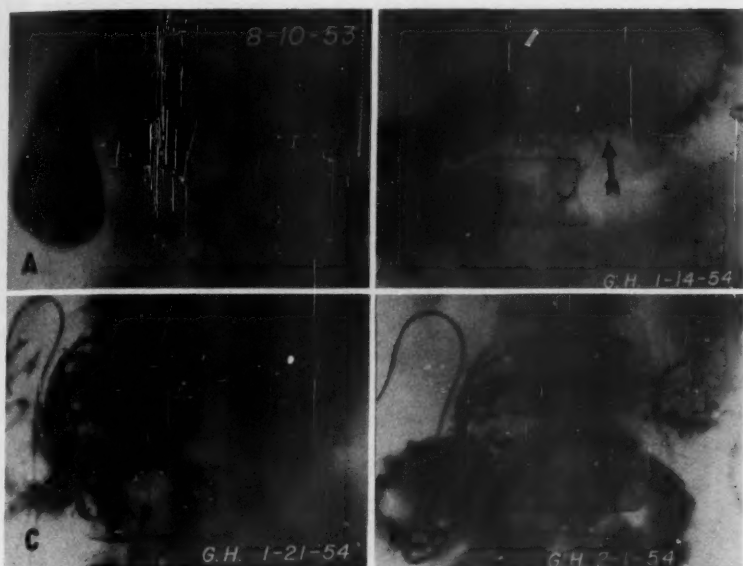


FIG. 7. Treatment of partial obstruction of the pancreatic duct by calculi. This patient with severe symptoms of pancreatitis had a mass of stones in the head of the pancreas (arrow) as well as a normal gallbladder (A). The pancreatogram at operation (B) revealed enormous dilatation of the pancreatic duct (arrow) as a result of partial obstruction. The gallbladder was removed, the sphincter of Oddi sectioned and a plastic tube inserted into the pancreatic duct. The calculi were removed by direct incision of the head of the pancreas, the incision closed, and the duct drained through the indwelling plastic tube. Pancreatogram 1 week after operation (C) revealed beginning organization of the space (arrow) which had held the stones. Eleven days later (D) the pancreatic duct was found to be restored and dilatation markedly reduced.

(d) Reaction to pain, emotion, drugs such as morphine, or to the application of an acid solution to the papilla, such as occurs prior to operation, is abolished (fig. 2).

(e) The sectioned sphincter heals in a position of retraction and does not reform (fig. 3). Since section of the sphincter is limited to a distance of 8 to 10 mm., the circular muscle of the duodenal wall, which acts ordinarily as a one-way valve, is not injured.<sup>1</sup> As a result, duodenal reflux does not occur (fig. 4).

(f) In 90 per cent of patients the results are considered good in that the patients are relieved of pain, gain weight, and return to their usual occupations. The majority of failures are in chronic alcoholic addicts.

(g) That the complications of pancreatitis, acute cysts, pseudocysts and fistulas are cured following sphincterotomy,<sup>4</sup> as a result of reduction in the pancreatic intraductal pressure (figs. 5 & 6). Sphincterotomy is ineffective if partial obstruction of the pancreatic duct is present. Additional procedures, such as direct removal of the obstructive stone (fig. 7), resection of the pancreatic tail (fig. 8), or pancreatic-caudal-jejunostomy, are necessary in such cases.



FIG. 8. *Persistent pancreatic fistula resulting from partial stricture of the pancreatic duct.* Following splenectomy, the patient developed a persistent pancreatic fistula. At operation this was found to be due to a partial stricture (arrow) of the pancreatic duct resulting from a transfixing suture which had been used to tie the splenic artery. The fistula was cured by removal of the tail of the pancreas up to the point of stricture. Note dilation of pancreatic duct behind the stricture (2 arrows).

#### DISCUSSION

##### *Clarification of the Relation of Fat and Alcohol to Pancreatitis*

The failure to achieve good results by sphincterotomy in alcoholic addicts and in patients who persist in eating fatty foods sheds light on the long established belief that these substances are of etiologic importance in pancreatitis. Observations on these patients show that one of the complications of pancreatitis is increased susceptibility of the injured organ to these substances. After disappearance of the inflammation and ensuing regeneration (as shown by serial secretin tests), the pancreas becomes normal and no longer reacts deleteriously to alcohol and fat.

It follows that sphincterotomy per se will not achieve good results in many patients unless they are kept on a low-fat and alcohol-free diet until the pancreas regenerates, a period of 6 months to 2 years.

Other operations in general use, such as choledochojunostomy, or pancreaticojunostomy, are based on the same concept. However, although choledochojunostomy does sidetrack the flow of bile and prevent reflux into the pancreas, it does not result in reduction of the pancreatic intraductal pressure. This factor is probably of some importance in the healing of pathologic con-



ditions present in that organ and is essential in the treatment of pseudocysts and pancreatic fistulas. Besides physiologic considerations, choledochojejunostomy is not only a more difficult procedure technically than sphincterotomy, but it also carries with it the possibility of stricture of the choledochojejunal anastomosis at a future date.

The anastomosis of the pancreatic duct at the tail of the pancreas to the jejunum may be necessary at times if the duct of Wirsung is partially obstructed by multiple calculi that cannot all be removed by direct incision. But it is a major procedure involving not only resection of the tail of the pancreas, which is buried in dense retroperitoneal fibrous tissue, but also frequently must include a splenectomy. In addition, if the pancreatitis patient does not already suffer from diabetes, he will often develop diabetes following this procedure, because the majority of islet cells in the human being are concentrated in the tail of the pancreas. Since this procedure is essential at times, a technic was developed to overcome these technical and physiologic difficulties. It can be called a "split pancreatico-jejunostomy." Pending a detailed report, the procedure can be summarized as follows:

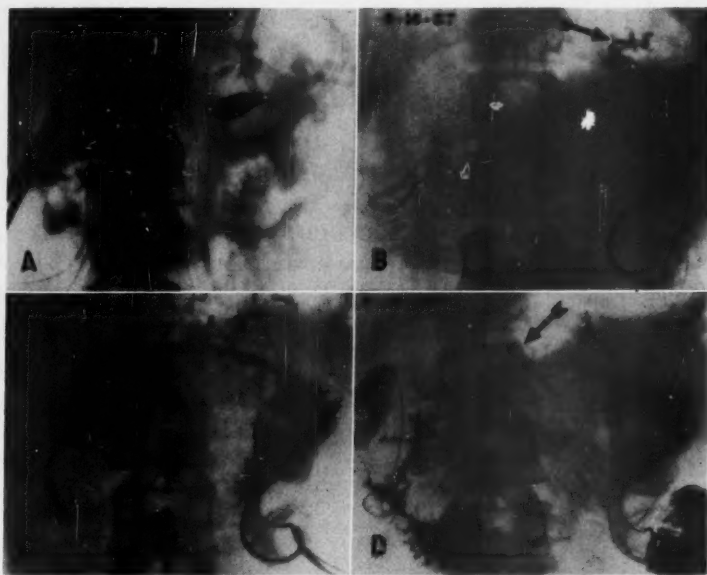


FIG. 9. Treatment of calcification with partial obstruction by split pancreatico-jejunostomy. An operative pancreatogram (A) revealed narrowing and partial obstruction of the pancreatic duct (arrow). Accordingly the pancreas was sectioned just to the left of the ligament of Treitz, and the end of the Roux en Y jejunostomy loop inserted. Each end of the sectioned pancreatic duct was anastomosed to the jejunum over a plastic tube. The tubes were brought out through the jejunal loop. One week later the duct in the tail (arrow) was visualized (B). Injection into the proximal duct (C) visualized the whole pancreatic duct and the tube passing through the ampulla (arrow). Injection (D) through this last tube, again visualized the narrowing of the duct (arrow).

The body of the pancreas is incised just to the left of the ligament of Treitz. The incision transects the pancreas without involving the splenic vein lying just posteriorly. The split is widened, by traction, a sufficient distance to insert the closed end of a Roux en Y loop of jejunum. An anastomosis is made on each side to the sectioned pancreatic duct, over fine plastic tubes which are brought out to the outside through separate openings in the jejunal loop. These are left in place for 2 months (fig. 9).

Pancreatectomy, as a form of treatment for calcification of the pancreas, cannot be justified. It is unnecessary, destroys whatever acinar function is left in the pancreas, excludes the possibility of regeneration, and produces diabetes if it is not already present. In addition, it removes the duodenum, important for proper digestion, in a patient already suffering from a severe defect due to impairment of pancreatic function.

#### SUMMARY

Sphincterotomy for recurrent pancreatitis is based on anatomic and physiologic principles and has achieved good results in a large group of patients. The operation is also successful in the treatment of such major complications of recurrent pancreatitis as acute cysts, pseudocysts, fistulas, and calcification of the pancreas.

*Dept. of Surgery  
N.Y. University  
College of Medicine  
550 First Avenue  
New York 16, N.Y.*

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## AN EVALUATION OF A NEW HIP PROSTHESIS USED IN SIXTY PATIENTS AND SIXTY-TWO HIPS OVER A SIX YEAR PERIOD

EUGENE L. JEWETT, M.D., F. DEWITT STANFORD, M.D.

*Orlando, Fla.*

Reconstructive or replacement orthopedic surgery for conditions affecting the component parts of the hip joint has been very much a problem for many years. Smith-Petersen's vitallium cup was the first successful metallic replacement procedure, although the various arthroplasties had been employed for many years before his cup was first used. Many fusion operations employed for disabling conditions of the hip joint are still very sound and should be used in certain well selected patients. Whether an arthroplasty, a medial migration osteotomy, a replacement procedure or an arthrodesis (fusion) should be done, demands in many instances a great amount of study and deliberation.

There is little doubt in the minds of most orthopedic surgeons that a very severely disabled hip in a young or middle-aged male who has to work and stand on his feet all day long is best treated by a fusion of that joint. There is also little question but that a replacement prosthetic procedure is indicated for an elderly patient with a necrotic or nonunited femoral neck, where the main objective is motion and ability to sit up and move about without the need for much weightbearing. In between these two definite classes of orthopedic situations we find a vast number of middle-aged or not too elderly people who have to be up and about and do a certain amount of walking, and in this group the problem is very often perplexing and demands a great amount of experience on the part of the orthopaedic surgeon and an understanding of the entire situation on the part of the patient and the patient's family.

There is a definite place, therefore, for a fusion of a hip, a vitallium cup arthroplasty, an osteotomy (high, medium or low) or one of the arthroplasty procedures such as Colonna, Whitman, Albee, etc., but I find little excuse nowadays for the use of the original Judet hip prosthesis. We have never used one of these prostheses. Beginning with the publication of Judet's original paper we did not believe that his prosthesis was structurally or mechanically sound and time has proved us correct in this reasoning. Of course, by using this prosthesis in many thousands of patients all over the world the orthopedic surgeon has gained great knowledge about this problem.

There are many types of excellent prostheses used nowadays and many an orthopedic surgeon has his own prosthesis. The authors started using the one under discussion in 1951,<sup>1</sup> with the idea that the hip nail would be a guide and would also help support the prosthesis without being made to sustain the entire weight or thrust of the body. We have seen several of the endoprostheses become loose with a marked "clunking" sound at each step the patient made or at times

From the Jewett-Wright Orthopaedic Clinic, Orlando, Florida.

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whenever the hip was moved at all and it was thought that this motion of the prosthesis in the femur should be—at all costs—eliminated or minimized. We did not see how a metal endoprosthesis that was loose enough to give a marked noise and a feeling of motion and insecurity could possibly become tighter through use. These people were either sent to bed for long periods of time or were put into short walking spicas with crutches and minimal motion of the involved hip joint. Most of them had pain when the hip would “clunk” and the joint felt insecure. Quite a few of these endoprostheses over the years have become completely dislocated or have protruded through the upper femoral cortex and have therefore had to be removed.

Another reason for beginning this endeavor was that we thought that if a patient had a nonunited neck of the femur or an aseptic necrotic head and the flange nail was in place, it would be a much easier matter to remove the necrotic head, smooth down the neck and simply put the prosthesis over the nail which was in situ. This has been done in many instances and has proved to be a good, sound procedure in a definite percentage of patients; especially in the aged, poor-risk individual.

In this series of 60 patients with 62 prostheses inserted (2 were bilateral) the first operation was performed on June 28, 1951, the last one on March 19, 1957. The last 5 patients had the new, longer, perforated stem type and in this the nail was not used. This prosthesis is so made that it can be inserted over one of our nails but it may also be used by itself as a true endoprosthesis and in this respect it has a broad enough stem so that it will not punch out through the lateral femoral cortex or dislocate. We believe that the straight type will have no tendency to seat itself unevenly, either against the femoral neck or in the intramedullary femoral cavity, such as is bound to occur every now and then in the case of the curved or angled prosthesis, which is fashioned after the original femoral head, neck and shaft.

One of our former associates, Dr. Ben Perry, used one of these new prostheses several weeks ago, over a Jewett nail, and he reports excellent progress of the patient to date.

In these 62 hip operations only one patient died soon after operation and she died the day after her surgery, probably from a pulmonary embolus. The next postoperative death occurred  $2\frac{1}{2}$  months after the second hip prosthetic procedure. She had had such a good result from her first prosthesis that she insisted on having the other hip operated upon, even though we tried to dissuade her from having this done. This patient was 78 years of age and had had many years of increasing pain and disability from arthritis of both hip joints.

In these 62 hips, seven nails became bent or broken and were either replaced or removed. None of the prostheses themselves broke.

There were 5 infections, or 8 per cent, in these 62 hip operations; 2 occurred in old, healed, fused osteomyelitic joints, 1 occurring 3 months after a normal healing per primam, when a ruptured appendix produced a massive intra-abdominal abscess with drainage and secondary infection to the hip joint; 1 from a blood stream infection (1 week postoperative) during a blood transfusion and soon

after a serious nephritis developed, and 1 patient whose hip became infected from either faulty technic, unsterile suture material or other causes.

In these 5 infected patients the prosthesis and nail were removed in 4, and in 1 the infection seems to be subsiding with the nail and prosthesis in situ. We have used all of the antibiotics as well as Rimifon and Marsilid, with the best results to date being obtained with Marsilid.

In the case of 1 patient—figures 7 and 8—a sterile synovitis resulted after a stainless steel prosthesis and nail were used in place of the vitallium Smith-Petersen cup and this prosthesis and nail were removed after the cup had been replaced by a prosthesis and nail.

In this series we have had 2 dislocations, 1 in the case of a patient who removed her Buck's extension the day after surgery—which held the leg in wide abduction—went to the bathroom unaided and dislocated the hip prosthesis. This patient would not allow us to reduce the dislocation and left the community shortly thereafter and to this date, I believe, gets about with the help of crutches with the prosthesis head still dislocated. She is much better, I understand, than she was prior to this operation. The other dislocation occurred when the patient sat up too early and adducted the involved limb, which was due to faulty following of postoperative orders. This prosthesis was reduced easily under gentle traction with the patient under anaesthesia and to date has remained in place with the legs in wide abduction—plaster boots and a forefoot broom-handle strut between them.

Many of these patients have been partially immobilized with the involved limb either in a plaster boot and a posterior bar or splint to keep the limb in-

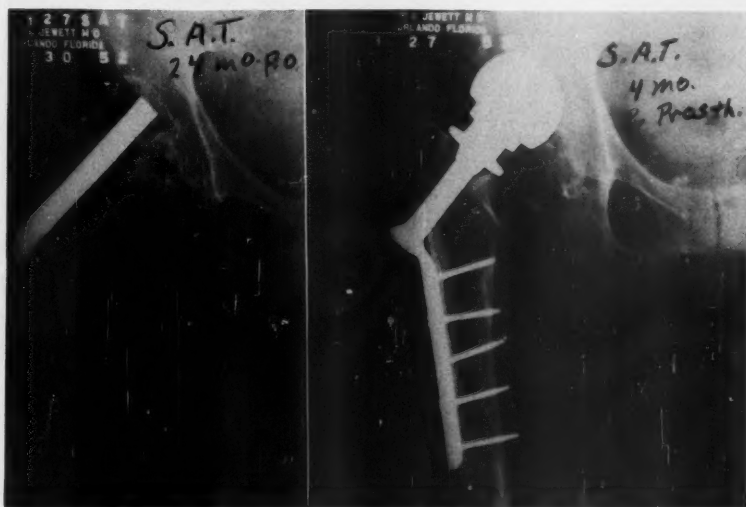


FIG. 1. S. A. T., 71 year old female, sustained a fracture of the right femoral neck in May 1949. On Nov. 6, 1952 the necrotic head was removed and a Jewett prosthesis put in. Patient now walking with one crutch, with no cane. Twelve month follow-up.

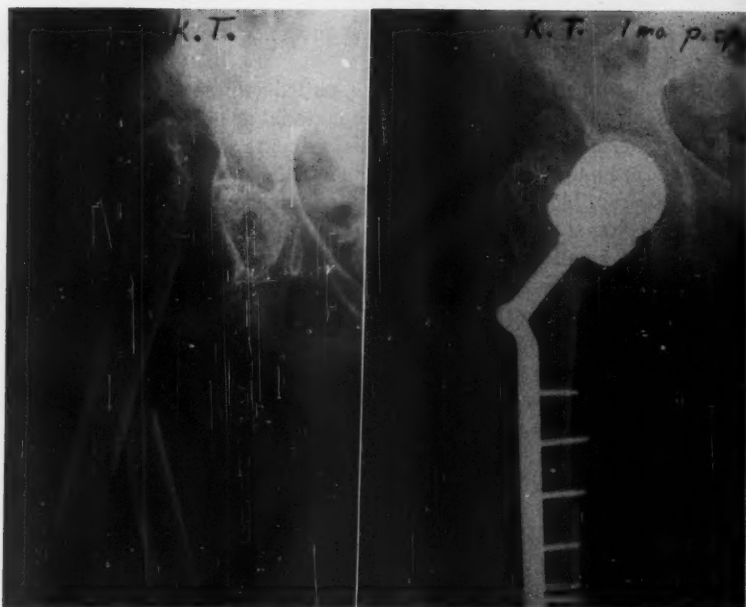


FIG. 2. K. T., 77 year old female, fractured the right femoral neck in April 1949. She was a Christian Scientist and consulted no doctor. On Nov. 7, 1953 she fell and fractured the shaft of the femur. An open reduction of the femoral shaft was performed and a long Jewett nail used for internal fixation of the shaft fracture. A prosthesis was put on the upper portion of the Jewett nail. Patient died from a cerebral hemorrhage 6 months later. She was comfortable until her death.



FIG. 3. K. T. Showing the distal portion of the femoral shaft, fixed with plate, screws and wire and the upper end of the femur with the prosthesis in place. This patient died 6 months postoperative from a heart ailment but during this time she was sitting up in bed and in a wheel chair without pain and developed no bed sores.





FIG. 4. B. O. T., 60 year old female, sustained a subcapital fracture of the left femur in a fall on Sept. 5, 1953. The next day the hip was nailed, using a Jewett nail. The nail cut through the superior portion of the femoral head. On Oct. 15, 1953 the femoral head was removed and a Jewett prosthesis put in place. The patient is walking with no pain in the left hip and has a fairly normal range of motion of that joint. Thirty-six month follow-up.



FIG. 5. S. S., 17 year old girl, sustained a dislocation of her left femur in an automobile accident in July 1939. She developed a fusion of this joint and an arthroplasty was done which held up for 2 years. Pain and limitation of motion developed and aseptic necrosis was seen.



FIG. 6. Same patient as in figure 5. A prothesis put in on March 3, 1953 which has held up well. The patient walking with one cane or crutch when outside but nothing when in the house. Forty-eight month follow-up.



FIG. 7. S. B. C., 45 year old male, developed aseptic necrosis of the femoral head from an injury of 9 years before. A Smith-Peterson vitallium cup was put in the right hip on March 31, 1952.



FIG. 8. Same patient as in figure 7. The vitallium cup was not satisfactory. This was removed and a Jewett prosthesis was put in on Nov. 24, 1953. The patient apparently developed a reaction to the change in the metal of the right hip. The prosthesis was removed because of the patient's pain on Nov. 24, 1954. The patient is now holding a job at the City Utilities plant with no pain in his hip, full weightbearing with no cane or crutch and is practically asymptomatic. Forty month follow-up.

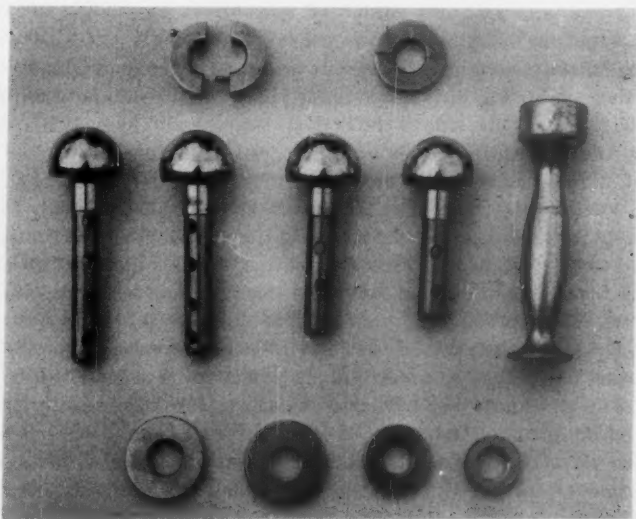


FIG. 9. Plate of new prosthesis and collars, some of which can be put on the neck of the prosthesis after the head of the prosthesis is in the acetabulum—head of prosthesis forced away from neck of femur by spreaders.



FIG. 10. M. C., 61 year old female, fractured the right femoral neck in September 1954. This was originally nailed with a Smith-Petersen nail which was later removed. She developed aseptic necrosis of the femoral head. On March 12, 1957 the femoral head was removed and a new Jewett prosthesis put in.

ternally rotated and abducted, or they have had Buck's extension to do the same thing, or they have had the leg put into a pillow splint with a sandbag so attached that the weight of it keeps the leg in internal rotation with the pillow and limb held over to the side of the body to prevent adduction. This abducted, internally rotated position of the limb has been maintained from 2 to 4 weeks but in a few patients we have allowed them to be sitting up in bed and in a wheel chair within  $1\frac{1}{2}$  weeks after the operation. We believe strongly that if the anterior approach is made into the hip joint the period of immobilization of the limb, as above outlined, need be only  $1\frac{1}{2}$  to 2 weeks, but if the posterior approach has been used we believe that the 3 week's immobilization period should be enforced. These prosthetic heads tend to dislocate posteriorly, we believe, and even though the capsule of the joint is incised from the superior anterior aspect (using a posterior approach) there seems to be a general laxity of the posterior soft structures which allows the dislocation more readily than if all of these supracapsular structures were uninvolved. Also, in the posterior approach the tip of the greater trochanter is removed along with the attached gluteal tendons and this has to be either sutured back in place or fixed with screws and this, we believe, warrants at least a 3 week's immobilization period.

In the anterior approach we usually do not sever the rectus femoris from its origins on the ilium but we do have to strip the tensor fascia lata from the ilium in about half of the patients, in order to put in the prosthesis and reduce it into

the hip joint. The extremely efficient ligament of Bigelow is a sufficient deterrent against anterior dislocation.

#### SUMMARY

Since June of 1951 this clinic has used a Jewett prosthesis in 62 hips in 60 patients. Two patients have had bilateral hip prostheses. These were used in four groups of patients:

1. For relatively fresh femoral neck fractures, 15 cases. Nine (60 per cent) were very satisfactory. Three (20 per cent) were unsatisfactory. Three (20 per cent) were good.

2. For old fractures with nonunion and/or aseptic necrosis of the femoral head, 30 cases. Nine (30 per cent) were very successful. Six (20 per cent) were unsatisfactory, although they all had much less pain than they had preoperatively. Fifteen (50 per cent) were good.

3. For abnormal relationship between the femoral head and the acetabulum, 12 cases. Five (42 per cent) were very satisfactory. Three (25 per cent) were good. Four (33 per cent) were unsatisfactory; although 3 of these 4 said they were better in regard to pain than they were before the operation.

4. For osteoarthritis of the hip joints, 3 cases. One (33 per cent) was satisfactory. Two (66 per cent) were unsatisfactory; although both of these patients had less pain than they had before the operation.

Of the 60 patients who have been operated upon to date, 43 cases have been followed for 6 months or longer. The average length of follow-up is 27 months. Of this group of 43 cases we consider 23 (53 per cent) patients to be excellent, 5 (12 per cent) to be good and 15 (35 per cent) to be unsatisfactory.

Five of these 62 hips became infected postoperatively and in 4 of these the prosthesis and nail were removed. All of these seem to be fairly well satisfied with their ultimate result and said they were definitely in less pain than they were preoperatively.

The authors are working on a combination prosthesis which will be composed of two parts; one, an endoprosthesis stem or distal part and a proximal component similar to the one used in the majority of the patients comprising this analysis. We strongly believe that a hip prosthesis appliance should be so constructed that as much of the length of the femoral neck as possible should be re-established, and to this end collars must be used. Also, we believe that in certain instances where the hip nail appliance is in place the aim should be to remove the necrotic head and involved neck of the femur and then place the prosthesis with, or without the collar, over the nail which remains in situ. These patients will be in the aged, debilitated group where motion, partial weight-bearing and relief of pain will be the main objects to be obtained. Hip nail appliances with angles of from  $135^{\circ}$  to  $155^{\circ}$  will be preferable for this purpose than those with less than  $135^{\circ}$  angles. Also, femoral flanges or plates should have at least 6 screws in them and the prosthetic stem should, after "settling" has taken place, come fairly close to the outer cortex of the femur and the angle of the nail and its flange. In many of these hips bone chips from the ilium should

be packed down around the Smith-Petersen nail part of the appliance and the stem of the prosthesis. This will protect the nail and its flange extension from undue stress in weightbearing (partial) or adductor muscle pull.

501 E. Colonial Dr.  
Orlando, Fla.

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## CLOSED RUPTURE OF THE TRACHEA

BEN F. MITCHEL, M.D., MILTON V. DAVIS, M.D.

*Dallas, Texas*

In those patients who have trauma to the anterior neck and chest and who have subcutaneous and mediastinal emphysema one must search for a break in the continuity of the respiratory tract. Certainly some instances are due to rupture of alveolar walls with dissection of air back along the bronchopulmonary tree to the mediastinum and neck. These ruptures are usually self-limiting and of little significance. Of much greater importance though, is the fact that even minimal subcutaneous and mediastinal emphysema may indicate a torn trachea.

The amount of emphysema present is not always an indication as to the size or degree of rupture present. A minimal amount of air and a stable clinical condition initially may deteriorate quite rapidly following a coughing episode. Other patients may do well at first and apparently be progressing to complete recovery only to develop progressive airway obstruction some 10 to 14 days later, the result of granulation tissue at the site of rupture. Obviously not every case of subcutaneous emphysema following trauma will follow these patterns. However when first seen we are not able to predict what course they will follow and for this reason careful observation is mandatory.

### REVIEW OF LITERATURE

In reviewing the literature, we have found substantiation for our feelings. Zeuch,<sup>32</sup> in 1922, was one of the first to report on subcutaneous rupture of the trachea. In this paper 53 cases of rupture of the cervical subcutaneous trachea were reported. Nine of these patients were treated by tracheotomy and the majority of them eventually succumbed to the effects of tracheal stenosis. That a major tear of the trachea may be present and initially not produce marked symptoms is illustrated by our Case No. 1 and the case of Richards and Cohn.<sup>25</sup> In the latter case the patient had mediastinal and cervical emphysema following injury which slowly subsided over a period of 10 days. During this time he developed increasing dyspnea which was not relieved by subsequent tracheotomy. Bronchoscopy revealed the true situation to be tracheal obstruction secondary to granulation tissue at the site of a tracheal tear just above the carina. The patient progressed to an eventual tracheal stenosis and the stenosis remains despite the heroic efforts of the authors to repair the defect. In 1952 Henry<sup>18</sup> reported a case of chest injury in which there was subcutaneous emphysema, hemoptysis, a paralyzed left cord, and pneumothorax. Conservative therapy was carried out. Fifteen days following injury the patient suddenly became very dyspneic. On bronchoscopy a tracheal tear  $1\frac{1}{2}$ " above the carina was seen.

From the Thoracic Surgery Service, Baylor Hospital and Parkland Memorial Hospital and the Department of Surgery, The University of Texas Southwestern Medical School, Dallas, Texas.

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The trachea was almost completely occluded by granulation tissue. A tracheotomy with a long tube was inserted through the area of granulation tissue. The patient developed tracheal stenosis. Henry concluded that early bronchoscopy would be of aid in diagnosing this type of injury and suggested the possibility of using long tracheotomy tubes to prevent stenosis.

Maloney<sup>20</sup> and Clerf<sup>3</sup> reported similar cases and in Clerf's patient a laceration of the trachea at the suprasternal notch was found. Surgery was performed and the laceration closed over a tantalum tube. The patient developed marked scar formation and was still wearing a tube at the time of his report. In Maloney's patient the only finding on admission was cervical emphysema, which was rapidly progressive. Bronchoscopy was done but during the course of the bronchoscopy the patient became markedly cyanotic and an emergency tracheotomy was performed to provide an airway.

Metson<sup>22</sup> reported 2 cases of rupture and concluded that conservative treatment should be tried if there is no progression of subcutaneous emphysema after several hours of observation. In one of his cases the patient's condition on first examination did not appear too grave, however there was rapid progression of symptoms later and an emergency tracheotomy as a lifesaving procedure had to be carried out.

Holinger,<sup>16</sup> in 1950, in a series of cases of benign stenosis of the trachea presented 3 cases of tracheal stenosis following trauma. He concluded that in severe injury with pneumothorax bronchoscopy is indicated to rule out the possibility of tracheal or bronchial tear. In the presence of a known laceration he thought that early dilatation would be of value. Numerous other authors<sup>2, 7, 10, 27</sup> in discussions of tracheal and laryngeal stenosis well indicate the difficulties of management if conservative therapy is followed in this type of injury.

#### DIAGNOSIS

In the more severe injuries involving the intrathoracic trachea or bronchi and in a few of those involving the cervical trachea, continued uncontrolled air leak will lead to the correct diagnosis of a break in continuity of the respiratory passages. If there is doubt as to the true cause of the uncontrolled air leak (persistent tension pneumothorax) bronchoscopy is indicated and will usually be followed by thoracotomy.

Major tears of the cervical trachea may not produce pneumothorax but there is massive cervical and mediastinal emphysema as well as marked respiratory distress. Some cases will be found during the course of an emergency tracheotomy for airway obstruction.

The treacherous group are those with minimal cervical or mediastinal emphysema who do not have pneumothorax, respiratory distress, or apparent serious injury. Hemoptysis and a peculiar change in voice may be noted. These findings are probably present in the more serious injuries but are overshadowed by their much more acute situation. This group of patients must be bronchoscoped to rule out a tear of the trachea or bronchi. Whether this is done as an independent procedure or following a prophylactic tracheotomy is a matter of personal

choice. We lean toward a prophylactic tracheotomy, followed by bronchoscopy through the tracheotomy, keeping in mind that the tear may be proximal to the tracheotomy site.

#### TRACHEOTOMY

Tracheotomy may well be unnecessary in many instances, but from the experience reported by others may prevent serious distress later. Bronchoscopy is simply performed via the tracheotomy and without undue trauma. By short-circuiting the vocal cords, tracheotomy decreases the intrabronchial pressure and to some degree prevents the straining, groaning type respiration which most of these patients have and which further complicates their condition by allowing them to force more air into the subcutaneous and mediastinal tissues with each forced expiration. It is also conceivable that tracheotomy, by not allowing high intrabronchial pressure to be attained, as in coughing, will prevent extension of present tears. It also serves to decrease the amount of dead space present and as a result increases the effective ventilation. In addition it gives an easy avenue to the repeated aspiration of tracheal and bronchial secretions.

#### REPAIR

The emphasis on early repair of tracheal and bronchial defects is directly related to the report by Scannell<sup>26</sup> in 1951, in which he repaired a torn bronchus immediately following injury. The reports of Gebauer<sup>12</sup> as well as Paulson and Shaw<sup>24</sup> have emphasized the excellent results obtained with suture in bronchoplastic repairs of the trachea and bronchi as well as the use of skin grafts, wire-supported, in the repair of tracheal and bronchial injuries and in bronchial stenosis.

Since these earlier reports, several authors<sup>6, 11, 13, 25, 31</sup> have reported primary repair of cervical and intrathoracic tracheal tears as well as tears of the major bronchi. Nach and Rothman<sup>23</sup> and Scott<sup>28</sup> reported cases in which there was laceration of the trachea, all of which were treated by direct suture and eventual good results. In order to avoid the serious complications of tracheal stenosis, early repair is indicated. In most instances this can be accomplished by careful reapproximation of the torn area with fine interrupted nonabsorbable suture material. It is probably best if these sutures do not extend through the entire thickness of the tracheal wall but pass just beneath the mucosa.

If early repair is not carried out, granulation tissue will form at the site of the tear. Secondary infection is quite apt to occur and as a result there is additional loss of tissue continuity. This was well pointed out by Richards and Cohn<sup>25</sup> and they advised against bronchoscopic removal of the granulation tissue because in doing so salvageable tracheal or bronchial wall may be removed. They believe that primary repair should be attempted even at this stage.

Certainly, all patients who have tracheal rupture will not require operative repair. Tracheotomy alone should suffice for small tears in which there is no displacement or malalignment of the cartilaginous rings and in tears of the membranous portion. These small tears can be followed by bronchoscopy and

if they do not progress satisfactorily, open repair can be done. The important thing is to know that a tear does or does not exist.

In those cases which do go on to stenosis following primary repair or those patients who have stenosis as a late complication, several methods of repair are available. Numerous investigators<sup>1, 4, 5, 8, 9, 14, 17, 18, 19, 21, 29, 30</sup> have studied ways and means of replacing the trachea or large tracheal defects in an effort to extend the operability of bronchogenic carcinoma as well as primary tracheal tumors. These procedures apply to traumatic tracheal stenoses as well. This experimental work has shown well that short segments of the trachea may be resected and a primary anastomosis carried out with good results. It appears that resection of small segments of the intrathoracic trachea are less likely to end in stenosis than are similar sections taken from the cervical trachea.

In larger defects where an end to end anastomosis is not feasible, several methods of bridging the defect have been tried. No method appears to be entirely satisfactory. It is well known that tissue continuity can be re-established but after removal of the stent or prosthesis which is used to bridge the defect, stenosis usually follows. Ekestrom's<sup>8</sup> recent report is encouraging. He uses a Teflon supported fascial graft, which requires two stages in its production.

Since in any tracheal tear the continuity of the mucous membrane is disrupted in some degree, the subsequent clearing of the tracheobronchial tree presents a problem. We have managed these patients by using constant warm nebulization for the first 5 to 7 days postoperatively. It is known that cold decreases ciliary action of the respiratory mucous membrane and that it also decreases the action of the bronchial musculature. It is for this reason that we believe that warm mist is much more preferable than the usual cold mist as obtained from the average nebulizing unit. Warming has been accomplished by placing the nebulizing unit in a hot water bath and maintaining the temperature in the water bath sufficiently high so that the nebulization mist will be warm to the back of the hand as it passes over the tracheotomy opening. Frequent aspiration of the tracheobronchial tree will be necessary in order to prevent pneumonitis from retained endobronchial secretions.

#### CASE REPORTS

Case No. 1, J. K., a 16 year old white male, was admitted to Parkland Hospital on Oct. 21, 1955 following an automobile accident in which the patient was thrown violently against the steering wheel. On admission he was in mild respiratory distress and there was moderate swelling of the anterior neck. In addition, there was point tenderness over the second and third costal cartilages anteriorly, and tenderness over the right clavicle. Roentgen examination of the chest revealed no evidence of pneumothorax (fig. 1). Posteroanterior and lateral films of the neck were obtained and revealed soft tissue swelling and retropharyngeal air (fig. 2). The patient was returned to the emergency room from X-Ray and on his return experienced a violent coughing attack. Immediately following this it was obvious that an increase in the swelling was present and the patient complained of increased difficulty in breathing. An emergency tracheotomy was then carried out and in the course of the tracheotomy an oblique laceration of the tracheal wall was found as depicted in figure 3A. The patient's respiratory difficulty was immediately relieved following tracheotomy. He was then taken to surgery, where under local anesthesia the tracheotomy incision was extended and the cervical trachea exposed. The oblique laceration was found and closed

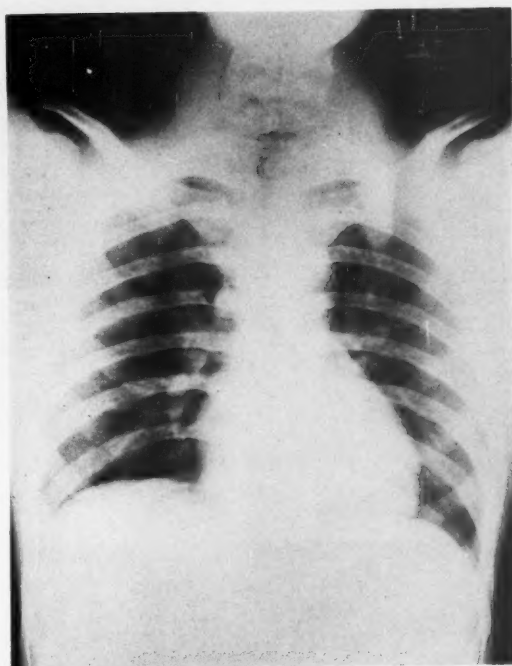


FIG. 1. Roentgenogram of the chest in posteroanterior projection in Case 1 showing no evidence of pneumothorax. Note soft tissue bulging in neck.

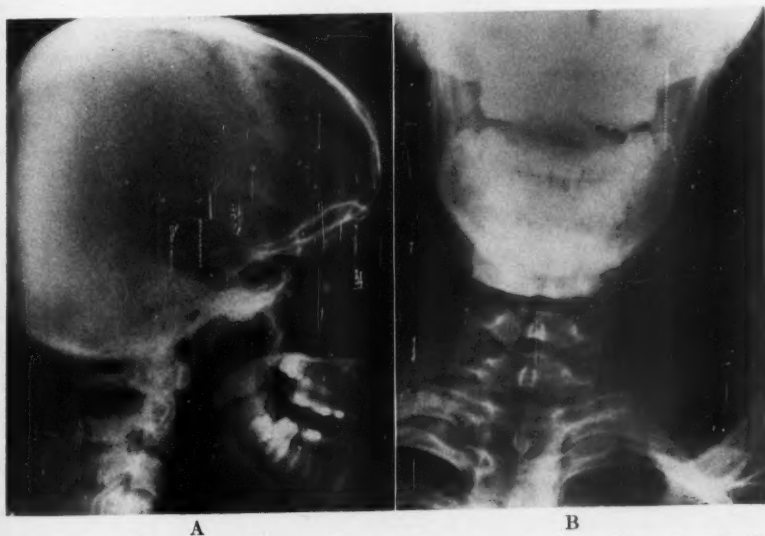


FIG. 2. A AND B. Roentgenogram of the neck in posteroanterior and lateral projections in Case 1 showing soft tissue bulging and retropharyngeal air.

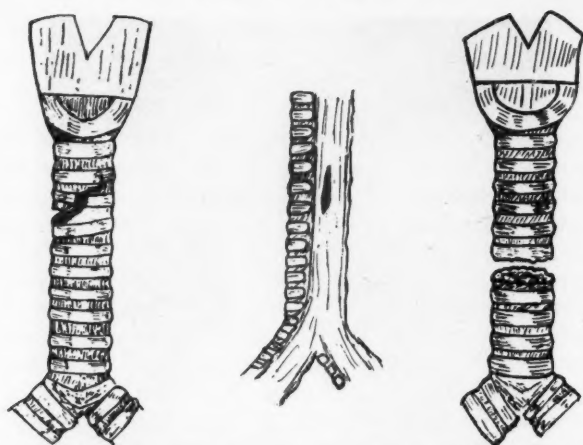


FIG. 3. Drawings of the trachea depicting the tears as seen in Case 1-A, Case 2-B, Case 3-C.

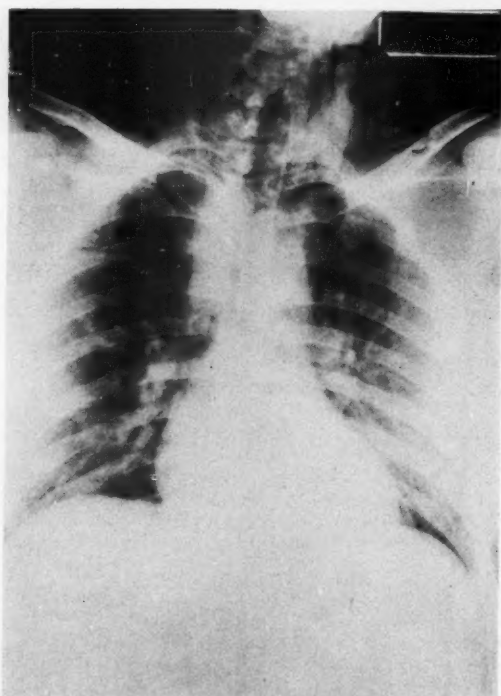


FIG. 4. Roentgenogram of chest in posteroanterior projection in Case 2 showing subcutaneous emphysema and no evidence of pneumothorax.



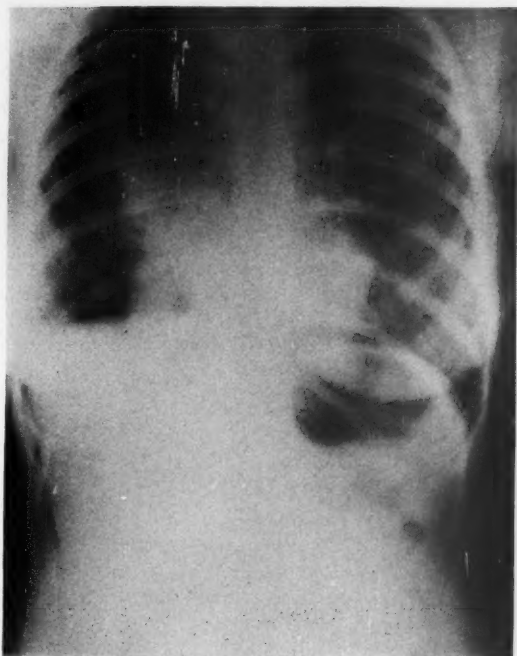


FIG. 5. Roentgenogram of chest in posteroanterior projection in Case 3 showing subcutaneous emphysema and pneumothorax.

with fine interrupted cotton sutures. Postoperatively the patient did well and the tracheotomy tube was removed on the tenth postoperative day. Bronchoscopic examination 6 weeks after injury revealed no evidence of tracheal stenosis.

Case No. 2, R. S., a 37 year old white male, was admitted to Parkland Hospital on June 3, 1956 following an automobile accident in which he sustained a fracture of the left arm and multiple abrasions and contusions. Minimal subcutaneous emphysema of the anterior neck and chest were noted on admission. Posteroanterior and lateral X-Rays of the chest revealed no evidence of pneumothorax (fig. 4). The patient was watched carefully over a period of several hours and there was no evidence of progression of the subcutaneous emphysema. However, in the light of previous experience a prophylactic tracheotomy was performed. Following tracheotomy bronchoscopic examination of the trachea revealed a 2 cm. linear laceration of the membranous portion of the trachea slightly to the right of the mid line (fig. 3B). The patient progressed satisfactorily and repeat examination of the chest revealed no evidence of pneumothorax. The tracheotomy tube was left in place until the June 18. Prior to its removal endoscopic examination of the trachea revealed a fine line of granulation tissue at the site of previous tear. The patient has had no difficulties since.

Case No. 3, D. F., a white female aged 21, was admitted to Baylor Hospital. She was seen approximately 40 hours following an automobile accident. Initial examination revealed the patient in marked respiratory distress and with massive subcutaneous emphysema. Posteroanterior and lateral examination of the chest revealed a right pneumothorax with mediastinal shift to the left (fig. 5). Closed drainage of the right chest resulted in immediate re-expansion of the lung and marked improvement in respiration (fig. 6). It was then noted that the patient had some difficulty in phonation and that her cough reflex was quite weak,



FIG. 6. Roentgenogram of chest in posteroanterior projection in Case 3 following closed chest drainage and re-expansion of lung.

more so than would be expected with the amount of chest wall injury. As the patient's condition appeared to be stable, she was transferred to Baylor Hospital. Because of a suspicion of a rupture in the trachea, the patient was taken to surgery where she was anesthetized and bronchoscopic examination was carried out. On introducing the bronchoscope into the trachea, a torn trachea wall was visualized with one of the cartilage rings protruding into the tracheal lumen. The bronchoscope was passed distally to a position just above the carina and anesthesia administered continuously through this. The anterior neck was then prepped and draped and a collar incision made and extended down to the pretracheal fascia. It was found that the fascia was apparently intact, however upon opening the fascia it was found that the trachea was completely severed and that the distal end had retracted beneath the sternal notch (fig. 3C). The distal end was grasped with two dural hooks and pulled into the cervical incision. By maintaining traction with the dural hooks the two ends were approximated and repair of the trachea was then carried out with numerous fine interrupted cotton sutures. As the site of anastomosis was quite low, a tracheotomy was performed above the site of anastomosis and a tracheotomy tube passed through it. The incision was closed in layers.

The patient did well postoperatively and she was discharged from the hospital on February 26 with the tracheotomy tube in place. She returned to the hospital on March 21 where bronchoscopic examination revealed no evidence of stricture. The tracheotomy tube was then removed.

The patient continued to do fairly well but remained mildly dyspneic and had some diffi-



FIG. 7. Stratogram of chest in Case 3 showing tracheal stenosis

culty upon exertion. In June 1955 stratigrams were obtained of the trachea and revealed a definite tracheal stenosis, as seen in figure 7. The patient continued to progress fairly well, having a slightly hoarse voice and slight dyspnea on exertion.

She was admitted to the hospital in December 1955 and an attempt was made to dilate the trachea. This was not successful. Pulmonary function studies were performed in May 1956 and revealed a moderate degree of both inspiratory and expiratory obstruction. It was then decided that an attempt would be made to resect the area of stenosis.

She was admitted to the hospital in July 1956 and the previous incision reopened and the area of tracheal stenosis found and excised, except for the posterior portion of the scar, which was left intact. An end to end anastomosis was accomplished. The tracheotomy tube was left in place postoperatively. Bronchoscopic examination following this repair revealed that there is still some stenosis, but her airway is quite adequate. Both vocal cords function normally; there is no hoarseness. Also, there is dyspnea only when the patient has a cold.

#### SUMMARY

1. The diagnosis and early treatment of ruptured trachea is discussed.
2. In the absence of pneumothorax and in the presence of cervical or mediastinal emphysema, rupture of the trachea should be suspected.
3. Three cases of traumatic rupture of the trachea are presented and the results of treatment are given.

4. Early recognition and repair of tracheal tears is needed in order to prevent the serious complication of traumatic tracheal stenosis.

*Suite 310*

*3707 Gaston Ave.*

*Dallas, Texas*

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## TREATMENT OF PERIPHERAL ANEURYSMS

REICHARD KAHLE, M.D.

*New Orleans, La.*

### INTRODUCTION

The remarkable advances in vascular surgery during the past few years have revolutionized the treatment of aneurysms of all parts of the aorta. The "stop-gap" methods of wrapping, wiring and various forms of ligation have given way to definitive replacement by grafts, even in the region of the aortic arch, where the hazards of interrupting circulation, even briefly, make this technical accomplishment difficult. In the light of these recent advances in aortic surgery, it seems pertinent to evaluate the surgical trends in the treatment of peripheral aneurysms.

### *Historical*

The lethal potentialities of arterial aneurysms have long been recognized, and the desirability of their complete excision must have been obvious even to ancient physicians. Accomplishment of this, however, was prevented by lack of means to control hemorrhage and infection. Even when the hemostatic clamp and ligature became available, infection and frequently gangrene of the extremity discouraged this radical approach. A milestone in the therapy of these lesions was passed in 1902 when Matas<sup>10</sup> emphasized the necessity of preserving collateral circulation by working within the aneurysmal sac and also pointed the way to preservation of continuity of the main arterial channel in selected cases by use of his restorative and reconstructive operations. As in aortic aneurysms, restoration of continuity is the keystone in the current management of peripheral arterial aneurysms. In this respect, Bickham's<sup>2</sup> operation (1904) of transvenous repair of the artery in cases of arteriovenous aneurysm has a distinctly modern flavor, and it still has a definite place in the current therapy of arteriovenous communications.

Methods such as wiring and wrapping, directed toward control of aneurysms of peripheral vessels rather than their cure, left much to be desired, and it was not until the renaissance of vascular grafting by Gross and associates<sup>6</sup> in 1949 that another milestone was reached in the surgical treatment of aneurysms of these vessels. Progress in selection, preservation, storage, and use of arterial and venous grafts, as well as development of plastic materials for this purpose, has been rapid and well documented.

### *General Principles*

The goal in the treatment of peripheral aneurysms should be restoration of continuity of the major vascular channel. Unlike slowly developing obstructive

From the Department of Surgery, Tulane University School of Medicine, New Orleans. Presented during the St. Petersburg Assembly of the Southeastern Surgical Congress in St. Petersburg, Fla., April 4, 1957.

lesions, arterial aneurysms are not usually accompanied by development of collateral circulation. Furthermore, even in locations where collateral circulation is adequate for viability, the amount of blood delivered to the periphery is never equal to that delivered by the principal artery. This is obvious when one realizes that flow is proportional to luminal area and that this in turn is a function of the square of the vessel radius. The inefficiency of collateral circulation has been demonstrated many times, even in the case of arteriovenous communications, where the tendency for collateral circulation to develop is well known.

#### *Factors Influencing Treatment*

Selection of a method of treatment of peripheral aneurysms may be profoundly influenced by the etiologic type of the lesion as well as by the duration of its existence. This is true because the pathologic changes in the aneurysmal wall and in the adjacent vessel may in one case permit restoration with use of the patient's own vessel, whereas in another, this may be extremely hazardous. Thus, a relatively recent arteriovenous aneurysm may often be repaired satisfactorily with transvenous suture of the arterial wall, whereas in an aneurysm of long standing, the degenerative changes in the adjacent vessel wall may make this a dangerous choice. Syphilitic aneurysms are prone to have a leathery type of sac and vessels that are more easily handled than those usually present in cases of arteriosclerosis. Calcific plaques, on the other hand, create technical difficulties. They must be handled properly in order to maintain patency in arteriosclerotic vessels.

#### *Methods of Treatment*

*Control Without Excision*—Wrapping, wiring, and ligation have little or no place in the treatment of aneurysms of the extremities. In the large major arterial channels continuity must be maintained or reestablished after excision. Ligation for mycotic aneurysms may represent the single exception to this.

*Excision of Aneurysms*—Obviously, aneurysms of smaller arteries that are expendable, either because of their small size or by their anastomosis with another vessel of adequate diameter as in an arcade, may be excised. Illustrative of this is the case of G. G., a white man, 43 years old, who complained of a painful spot in the palm of his right hand, which was most distressing when he shook hands or worked with tools. Several years previously, he had sustained a penetrating wound in the anatomic snuff box caused by window pane glass. At operation, a small aneurysm of the radial artery was excised, as obviously the ulnar artery through the volar arches would provide adequate circulation for the hand. Aneurysms of the anterior or posterior tibial artery could be similarly handled. Although excision of aneurysms dates back to antiquity, the operations of Matas resulted in almost complete discard of excisional methods for larger aneurysms.

*Traumatic (False) Aneurysms*—Traumatic aneurysms are still frequently mismanaged. A discussion of treatment of these aneurysms should properly begin with prevention, since recognition and repair at the time of injury to the



major vessels will avert the more difficult problem of repair of the false aneurysm that develops later and the inherent danger of secondary hemorrhage that exists until the injured vessel has been repaired. Much can be accomplished by proper training of medical students. As interns and junior residents they will be treating the original wound in the accident room. Too often bleeding of a femoral or brachial artery has been stopped by pressure and application of a tight dressing only to have an aneurysmal swelling appear later.

This has been forcibly impressed upon me many times but perhaps never more strikingly than in the case of D. T., a Negro woman, 24 years old, who was admitted to Charity Hospital in New Orleans in June 1952 with a pulsating hematoma in the left axillary region, 24 days after having been stabbed. At the time of injury a diagnosis of laceration of axillary vessels had been made in the accident room but it was decided that an "operative procedure was not indicated." Operative repair of the aneurysm on admission was advised but the patient insisted on first going home to "straighten out her affairs." She was readmitted 2 days later, but almost simultaneously with her arrival on the ward, the aneurysm ruptured, and it was necessary to maintain digital pressure on the vessel until the operating room could be prepared so that the axillary artery could be exposed. The artery was completely transected. In spite of the age of the injury, end to end anastomosis was successfully accomplished after the edges of the vessel had been freshened. The radial pulse, which had been absent, became palpable and remained so.

An artery that has been partially or completely severed can usually be repaired primarily, if sound surgical principles are applied. This is illustrated by the report of Morris, Creech and DeBakey.<sup>11</sup> Of 92 injuries to major arteries, treated chiefly by the resident staff, 60 were repaired by primary suture and 29 by ligation. In 52 of the 60 injuries primarily repaired (86 per cent), peripheral pulses were restored.

*Arteriosclerotic and Syphilitic Aneurysms*—Although there may be some pathologic differences in peripheral aneurysms of arteriosclerotic and syphilitic origin, their surgical management presents essentially the same problems. In both, but particularly in the arteriosclerotic type, the degenerative changes may make reconstructive effects with use of the patient's own arteries difficult. It is in these varieties that grafts are likely to be most useful.

It should be pointed out, however, that occasionally after resection of an arteriosclerotic aneurysm the defect may be bridged by end to end suture of the vessels in spite of a large aneurysmal sac. Cases that may be handled in this way actually have only a short distance between afferent and efferent arteries, and the sac arises from a relatively short segment of diseased vessel, although it may overlay a much larger area. Careful dissection of the vessels approaching and leaving the sac is necessary to preserve length. This was accomplished by Enderlen as long ago as 1907 and has recently been reemphasized by Creech<sup>3</sup> in connection with popliteal aneurysms.

The case of J. M. illustrates management of a popliteal aneurysm in this manner. From external appearances the size of the sac would have seemed to

make primary suture after resection impossible, and yet after removal of the sac, a defect of approximately only 4 cm. remained. This Negro man, 66 years old, was admitted to Charity Hospital in New Orleans on Feb. 16, 1956 with a diagnosis of bilateral popliteal aneurysms. On the right, rupture was imminent. The huge swelling had almost eroded through the skin. An area of skin approximately 2 cm. in diameter was necrotic and surrounded by an inflammatory reaction. At emergency operation, after the posterior tibial and peroneal components of the sciatic nerve were isolated and protected, control of bleeding from the artery was obtained proximally and distally. After excision of the sac as closely as possible to the efferent and afferent components, a gap of approximately 4 cm. remained. This was bridged by flexion of the knee and suture of the vessel end to end without undue tension on the suture line. The wound was closed loosely. The dead space left by removal of the huge aneurysmal sac without soft tissue available to fill it was undesirable but unavoidable.

*Matas' Restorative Endoaneurysmorrhaphy*—That there is still a definite place for Matas' restorative endoaneurysmorrhaphy (fig. 1), introduced nearly half a century ago, is a frequently overlooked fact. The principle is sound and use of the patient's own artery, if feasible, is certainly preferable to a graft. Illustrative of this is the case of C. P., a Negro man 59 years old, who was admitted to Charity Hospital in New Orleans on Jan. 17, 1955. Thirty-five years before he had been shot with a 32 calibre pistol. On examination a pulsating mass was seen in the upper portion of the right thigh. At operation on Jan. 27, 1955 the aneurysm was found to involve the superficial femoral artery just below its origin. Branches of the femoral nerve were dissected from the sac, and the artery was occluded proximal and distal to the sac with special arterial clamps. The sac was incised and a 4 mm. opening in the wall of the artery was repaired with no. 00000 arterial silk. This resulted in good pulsation and a warm foot distally. The patient was discharged Feb. 7, 1955. Circulation in the right lower extremity has remained good. Pulsation is present in the dorsalis pedis and the extremity is asymptomatic.

The obliterative and reconstructive varieties of endoaneurysmorrhaphy were brilliantly conceived to circumvent the limitations of treatment extant at the

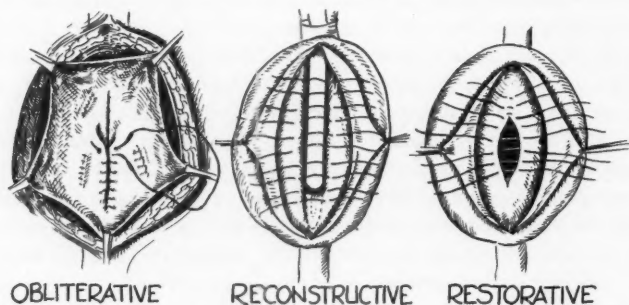


FIG. 1. Matas aneurysmorrhaphy. Intrascapular operations diagrammatically represented.

time of their origin. Although some surgeons are still partial to these techniques in selected cases, a vascular graft is almost always preferable, because in the obliterative variety the main channel is occluded. In the reconstructive operation a new vessel is created out of the aneurysmal sac. Although its objective of recreating the major vessel is good, this operation is less desirable than grafting, since the new vessel must be reconstructed from diseased tissue. Probably thrombosis and recurrence of the aneurysm are more likely under these circumstances than in a graft.

*Grafts*—If primary anastomosis cannot be accomplished after excision, three possibilities for reconstruction exist: use of a homologous arterial graft, an autogenous venous graft or a synthetic graft, such as nylon. Each type has its proponents.

Lord and Stone,<sup>9</sup> for instance, reported use of autogenous venous grafts in 12 cases of nonobliterative disease (injury, aneurysm, and arteriovenous fistula) with good long term functional results and absence of aneurysmal dilatation. Jahnke and Seeley<sup>8</sup> demonstrated the possibility of using autogenous vein grafts in vascular war injuries. Deterling,<sup>4</sup> on the other hand, believed that, except in cases of short replacement where venous grafts are satisfactory, arterial homo grafts are preferable.

The successful use of nylon tubes in bypassing obliterative peripheral disease would certainly suggest that they would make satisfactory replacements for excised aneurysms of major vessels. The danger of thrombosis may be expected to be considerably less than in the bypass operation, since the most important factor in continued patency of these grafts is a good distal flow (run-off) and this is usually present in aneurysms.

The use of grafts to replace segments of major peripheral vessels resected for arteriosclerotic aneurysm is well illustrated by the case of R. B., who had bilateral popliteal aneurysms. This schoolmaster, aged 66 years, was first seen in June 1956 because of moderate ischemia in the right lower extremity. The right popliteal aneurysm, which measured 14 by 7 by 7 cm., was excised on Aug. 16, 1956 and replaced by a homologous graft. After operation, pulsation appeared in the posterior tibial at the ankle and remained good, and the foot became warmer. On Oct. 27, 1956 the aneurysm of the left popliteal artery, which measured 14 by 7 by 5 cm., was resected and replaced with an Edwards-Tapp crimped nylon tube  $\frac{1}{2}$  inch in diameter. Although the homologous graft was functioning satisfactorily, when the second operation was performed 2 months after the first, an Edwards-Tapp tube was chosen because these prostheses had become locally available and because such a graft seems less likely to thrombose in cases in which the flexion crease behind the knee must be crossed.

*Mycotic Aneurysms*—These are due to infection from an extravascular source or more commonly an intravascular source. An example of a mycotic aneurysm developing from an extravascular source is the case of a Negro man who had primary suture of the popliteal artery after excision of the sac. Secondary hemorrhage on the twenty-sixth postoperative day was found to come from the artery above the suture line and not from the site of anastomosis as expected.

It was erroneously assumed that this arose from the weakening of the wall by application of an arterial clamp, although in retrospect this probably was not the only factor, and infection, enhanced by the dead space left by the large sac and the ulceration of the skin at the apex of the aneurysm on admission, probably were also involved. The aneurysm and adjacent vessel were excised and a graft was inserted. Had infection been suspected, a graft would not have been used. As a result of this infection, which later became more evident, hemorrhage again occurred, this time from disruption of the graft, and it was necessary to ligate the vessel.

Mycotic aneurysms may occur from the lodging of an infected embolus in an artery or the deposition of microorganisms on the intima or in the arterial wall by means of the vasa vasorum. The most common causative organism is the streptococcus, as would be suspected from the fact that subacute bacterial endocarditis is the most frequent predisposing infection. Destruction of the wall is well localized as a rule but weakening is rapid so that the lesion enlarges quickly and is prone to rupture.

Excellent reviews of the subject have recently been published by Barker<sup>1</sup> and Hankins and Yeager.<sup>7</sup> It is generally agreed that the prognosis is grave and that in many instances the aneurysm may be surgically inaccessible. It is best to excise the lesion in order to prevent fatal hemorrhage. Because the aneurysm enlarges so rapidly, operation may have to be performed before optimum conditions can be obtained by antibiotic therapy and cardiac management. The difficulties of management under these circumstances are illustrated by the case of W. A., a white man 51 years old, who was admitted to Mercy Hospital on Feb. 17, 1954. He had had fever and articular pain of unexplained origin for approximately 3 months. About 4 months after onset of the present illness he experienced sharp pain in the right thigh which persisted. Three weeks before admission, a swelling developed in this area and grew progressively larger. On examination a large mass was seen in the upper portion of the right thigh with a definite expansile pulsation. Although efforts to prove the presence of bacterial endocarditis or rheumatic fever had been fruitless, it was believed that because of its rapid growth, the aneurysm was mycotic. Imminent rupture made operation mandatory in spite of the possibility of associated myocarditis and valvulitis.

During induction of anesthesia, cardiac arrest occurred. When the chest was opened, cardiac standstill was noted. Contraction resumed with massage and recovery was apparently complete. At operation 1 week later a large mycotic aneurysm of the common femoral artery was excised and repair was accomplished by primary suture. As the wound was being closed the patient died. At postmortem examination a ruptured aortic cusp was considered to be the cause of death.

Resort is usually to ligation of the vessel proximally and distally after removal of the sac, but as Barker<sup>1</sup> suggested, an autologous vein graft may be considered if repair seems necessary.

Use of a graft in the face of infection poses a serious decision. The potenti-

alities of failure are exemplified in the following case. An acutely ill Negro man, 23 years old, was admitted to the Infectious Diseases Service of Charity Hospital, Feb. 8, 1955, complaining of headache, chills, fever and sweats of 3 weeks' duration. One week after onset he noted a "lump" in his right calf, frontal headache and visual disturbances. About 10 days before admission he noted swelling in the upper portion of the right thigh. Headache became severe and the neck became stiff. There was a history of "dropsy" and "enlarged heart associated with joint pain" at the age of 8 years.

On admission, the temperature was 102.4F. Nuchal rigidity was noted. There was clinical evidence of cardiac enlargement and a systolic thrill was detected at the apex. Systolic and diastolic murmurs were present over the lower precordium. On the anteromedial aspect of the upper part of the right thigh a swelling approximately 10 by 7.5 cm. was noted. The skin over this mass was hot and the region was tender. Pulsation was present in the femoral but not in the popliteal and pedal vessels on this side. The white blood cell count was 16,150 per cu. mm. Results of repeated blood cultures were negative. Pulsation and a systolic murmur were noted in the femoral mass on Feb. 11, 1955. Inflammatory signs over the mass began to subside about this time. Nodules developed on the dorsum of the left foot and right palm. Pus was aspirated from the latter. On February 23, the femoral mass became painful and rapidly enlarged. On February 25 an emergency operation was undertaken for ruptured mycotic aneurysm. The femoral artery was secured proximally. The clot was evacuated and the artery was found to be destroyed. The lesion was in the superficial femoral artery just below its origin.

The femoral vein was thrombosed. A defect 6 or 7 cm. long remained in the artery. A segment of the adjacent saphenous vein was removed and used as a graft, it being reversed end for end. Upon removal of the clamp, flow through the graft was good and the temperature of the foot improved. Dorsalis pedis pulsations were restored. A small drain was left in the wound.

The temperature came down and the foot remained warm. The wound apparently was healing satisfactorily until the sixth postoperative day, when slight drainage began. On the seventh postoperative day, drainage increased and the next day hemorrhage necessitated reoperation. The bleeding came from the femoral artery about 2 cm. proximal to the upper suture line of the graft. Because of infection, the graft was removed after the artery had been ligated. The lumen was partially occluded by a recent clot. The wound was again drained. The extremity now has good function.

*Arteriovenous Aneurysms*—Aneurysms in which there is a communication between the arterial and venous systems present several unique features that in some measure make them the most interesting of all. Time does not permit consideration of the effects on blood volume, myocardium and vessel walls. Directly related to their treatment, however, is their well known tendency to evoke increase in collateral circulation. Until recently, the operation of choice for these lesions, if transvenous repair was not feasible, was quadruple ligation. As emphasized by Gerbode and associates,<sup>5</sup> however, the functional result after



this operation has not always been ideal. The desirability of a determined effort to restore circulation in the major vessels by the use of grafts has been demonstrated by the experiences of Seely and associates<sup>18</sup> in the recent Korean War.

If the vessels are small and expendable, ligation and excision, of course, may be employed. Two cases of arteriovenous communication of the profunda femoris vessels in the mid thigh have been handled in this manner with good results.

Adherence to the principle of restoration of the major vessel is illustrated in the following case in which a "patch" graft was used in preference to sacrifice of the brachial vessels involved in a traumatic arteriovenous communication. R. R., a boy 12 years old, was seen in consultation on Feb. 10, 1956 because of progressive swelling in the left antecubital area. He had accidentally stabbed himself in the left forearm with a linoleum knife 9 weeks before. The classical signs of an arteriovenous aneurysm of the brachial vessels were present just above the bend of the left elbow. On obliteration of the thrill by pressure, the radial pulse, which was faint, disappeared and the hand became pale and slightly cyanotic.

Although the extremity was considered to be viable, obviously ischemia would be severe if ligation became necessary. The rapid enlargement of the aneurysmal mass and its superficial position threatened early rupture and made waiting for further development of collaterals seem hazardous. At operation on Feb. 16, 1956, the involved veins and sac were excised, and a triangular defect in the wall of the brachial artery just above its bifurcation was patched with a triangular segment of homologous graft. Direct suture without grafting would have undoubtedly constricted the artery and invited thrombosis. Restoration of normal flow has resulted not only in a viable extremity but in normal growth and function.

Restoration of the major vessel is also exemplified in the case of A. C., whose chronic arteriovenous fistula of the axillary vessel was cured, not only by suture of the artery but by repair of the vein as well. This could be accomplished only after extensive dissection of the vessels proximally and distally to gain control of them. The patient, a white prisoner, 28 years old, had been shot with a 38 calibre bullet in the right pectoral region during an attempted robbery 8 years previously. Cardiac symptoms were not severe but progressive enlargement of a mass beneath the right clavicle with a gradually increasing sense of tightness in this region caused him to request treatment. At operation, after the insertion of the right pectoral muscles had been severed, both the axillary artery and the axillary vein were isolated on each side of the communication. After application of atraumatic arterial clamps, the vessels were separated and the rent in each was sutured, with restoration of continuity to both, recovery of the patient and return of function without impairment of venous competency.

Still another means of achieving this same end was employed in the case of a Negro man 23 years old who had an arteriovenous aneurysm of the common femoral vessels as a result of a bullet wound 8 years before. Here, the artery was sutured through the venous sac, as advocated by Bickham, with immediate restoration of dorsalis pedis pulse and rapid disappearance of an ulcer in the



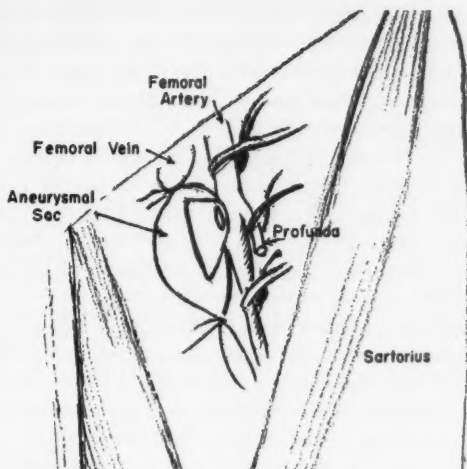


FIG. 2. Transvenous repair of arteriovenous aneurysm of femoral vessels

leg (fig. 2). The patient was admitted to Charity Hospital in New Orleans, complaining of muscular weakness of the left leg and an intractable ulcer of the lower third of this leg. He had been shot with a 22 calibre bullet through the upper portion of his left thigh several years previously. The classical signs of an arteriovenous aneurysm were present in the upper portion of the femoral triangle, and pulsation was absent in the pedal vessels. Cardiac signs and symptoms were minimal. Transvenous aneurysmorrhaphy resulted in return of the pedal pulses on the operating table with healing of the ulcer in the leg in approximately 3 weeks.

#### DISCUSSION

It is thus evident that surgical means are presently available to restore, in most cases, the blood flow in the principal arterial channels after resection of aneurysms, whatever their etiology. Therefore, there is much less need now for depending on collateral circulation and use of sympathectomy. The feasibility of vessel grafting has given the modern surgeon a powerful weapon that now enables him to think in terms of restorative surgery.

Like other adjuncts that have augmented the surgical armamentarium, however, grafts must be judiciously used. Never, other things being equal, will a graft, be it organic or plastic, serve as well as the patient's own vessel, and if primary or delayed repair can be accomplished without violation of fundamental surgical principles, obviously this is the method of choice. If a graft is necessary, there should be no hesitation to use one. The choice of autogenous vein, homologous artery or plastic is an individual one at present, since experimental and clinical experience has not yet settled which is best. The ideal one has probably not yet been found.

If an artery bank is available, my preference would be a homologous graft because of longer clinical experience with this type and because of greater ease of suturing. Also with homologous grafts there is probably less danger of thrombosis in grafting smaller arteries than with the plastic tubes. The crimped type of tube, on the other hand, seems to offer an advantage if a flexion crease, such as the knee, must be crossed. Autogenous vein grafts eliminate the danger of antigenic factors but great care must be taken to match vessels in size. The dilatation of the thin walled vein, when subjected to arterial pressure, has been disturbing to me in a limited experience with such grafts, although it is realized that the tendency to dilate may be offset by wrapping with fascia or some other strengthening material.

It is to be fervently hoped that in the enthusiasm for grafts, old methods will not be forgotten but that they will be kept as part of a versatile surgical armamentarium. Transvenous repair of an artery in arteriovenous fistulas, provided the arterial wall has not undergone degeneration, may be used to advantage and occasionally the Matas type of restorative aneurysmorrhaphy may be the operation of choice if the wound in the arterial wall is laterally situated. The advisability of resection of aneurysms in small expendable arteries has been mentioned and the possibility of primary anastomosis after resection of even large aneurysms has been noted. These alternative methods have been considered, lest the pendulum be allowed to swing too far in favor of grafting. The future of grafts, even in peripheral vessels, seems good but should not be marred by indiscriminate use. The choice may be difficult in the care of mycotic aneurysms where infection and foreign body present an undesirable combination. It is one which must be weighed against possible gangrene if the alternative of ligation alone is chosen.

The presence of infection in association with aneurysms would militate against the use of a graft, and certainly the precursors of infection, such as dead space, damaged soft tissue, and contamination, should be carefully evaluated before resort is had to a graft. Fortunately, in most cases, the blood flow in the major vessel can be restored and this primary objective should be kept in mind at all times.

#### SUMMARY

Methods of treatment of peripheral aneurysms have been considered in the light of trends induced by recent successes of vascular grafts. The goal in the treatment of aneurysms of arteries of significant size should be restoration of continuity of the major vascular channel. This goal is often best achieved by use of grafts, although the choice of the type of graft is subject to individual preference. Although grafts have greatly enhanced the possibilities of restoration of normal blood flow, the same end may sometime be better achieved by older methods in which the patient's own vessels are used. Primary and secondary repair of arterial injuries in false aneurysms, resection and primary anastomosis of the vessel ends, the transacicular restorative operation of Matas, and the transvenous repair of arteriovenous fistulas are examples. Prevention of false aneurysms by proper care of arterial injuries at the time of the original accident

has been emphasized. Attention is called to the necessity for carefully evaluating the exceptional circumstances associated with mycotic aneurysms in which the potential danger of infection makes grafting hazardous.

1441 Delachaise Street  
New Orleans, La.

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## HYPOSPADIAS

ROBERT F. HAGERTY, M.D., ELSIE TABER, Ph.D.

*Charleston, S. C.*

In the hypospadiac deformity the abnormal urethral opening may be located anywhere between the glans penis and perineum, with deficiency of the distal urethra. Most common is the glandular type (40-74 per cent), with the penile type next (12-30 per cent), and the more severe scrotal and perineal types least common (10-15 per cent) (fig. 1).<sup>7, 31</sup> Associated with the urethral defect and usually in direct proportion to it is the chordee, the marked ventroflexion of the penile shaft, produced by a broad fibrous band, the sclerosed corpus spongiosum, along its ventral surface. As a result there is a marked deficiency of ventral integument. The dorsal prepuce, however, is consistently present in abundance and is made up of many folds, giving rise to the term dorsal hood or monk's hood. Among the other abnormalities which may be present are cryptorchid testis, bifid scrotum, rudimentary penis, enlarged prostatic utricle, and congenital hernia.

### INCIDENCE

Hypospadias is one of the most common anomalies of the male reproductive system. In a careful study of the case records of 27,613 boy babies, born in a Copenhagen hospital between 1910 and 1945 and thoroughly examined for congenital defects, Sørensen found 90 with hypospadias, or 0.33 per cent.<sup>31</sup> Malpas studied 16 cases occurring in 13,964 male births at Liverpool Maternity Hospital between 1923 and 1932, and observed that the abnormality was significantly more common in first births, regardless of maternal age.<sup>19</sup> Since age of mother and birth rank tend to be correlated, Malpas' conclusion is partially supported by the 1950 report of Büchi (cited by Sørensen) that, in 244 patients, there was a tendency for hypospadias to occur more frequently in the children of young mothers.

### EMBRYOLOGY

For an understanding of the various types of hypospadias and the other anomalies that frequently accompany the more severe forms, it is necessary to review the embryologic development of the genital systems.

By the beginning of the seventh week, the human embryos of both sexes possess two embryonic duct systems, Wolffian and Müllerian, which can give rise to accessory sexual organs of the male and female, respectively. Externally, a conical elevation, the genital tubercle, has formed on the midline between the umbilical cord and the tail. Caudal to the tubercle is the shallow urogenital

From the Departments of Surgery (Plastic) and Anatomy, Medical College of South Carolina, Charleston, South Carolina.

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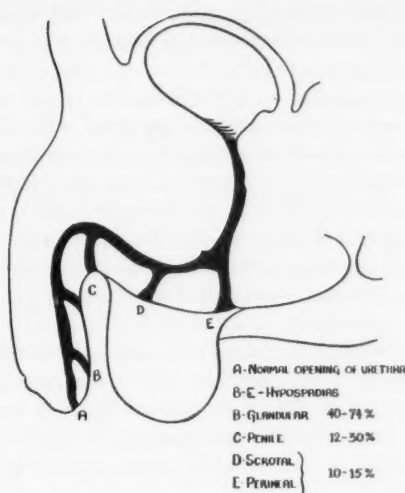


Fig. 1. Location of urethral meatus in the normal and in various types of hypospadias

groove, separated from the internal urogenital sinus by a thin membrane. Forming the lateral boundaries of the groove are the slightly elevated urogenital folds, flanked by the labioscrotal swellings. During the seventh week, the genital tubercle elongates into a somewhat cylindrical organ with the knob-like glans at the apex. The urogenital membrane ruptures so that the sinus opens between the urogenital folds. In the male this opening extends into the region of the glans, whereas in the female it terminates some distance below the apex. Another sexual difference, which becomes more noticeable at later stages, is the caudal curvature of the glans region in the female, possibly caused by the greater growth of the cavernous over the urethral region of the tubercle.

During the tenth to sixteenth weeks a series of changes occurs leading to the formation of the typical male or female fetus. In the male, the Müllerian ducts regress, leaving small rudiments such as the prostatic utricle; the Wolffian ducts differentiate into the epididymides, the vasa deferentia, the ejaculatory ducts and give rise to the seminal vesicles. In the female, the Wolffian ducts regress; the Müllerian ducts differentiate into the oviducts, uterus, and all or part of the vagina.

In the male, the urogenital folds fuse at the midline to close the orifice of the urogenital sinus and to form the tubular cavernous urethra within the shaft of the penis. Fusion is from the base distally and, by the fourth month, the orifice is closed as far as the glans. Distal to this the urethra continues as a groove in a thickened epithelial plate, which later closes, giving the urethra its permanent opening at the tip of the glans. The labioscrotal swellings shift caudally and merge with each other to form the scrotum.

In the female, the genital tubercle lags in development and becomes the

clitoris. The urogenital groove remains open as the vestibule, with the urogenital folds persisting as the labia minora and the labioscrotal swellings as the labia majora.<sup>1, 32</sup>

From an embryologic point of view, the least severe and most frequently encountered glandular type of hypospadias is caused by lack of closure of the epithelial plate on the under surface of the glans; the penile, scrotal, and perineal types are caused by incomplete or lack of fusion of the urogenital folds. Therefore, hypospadias can be considered as an example of developmental arrest and the earlier in development the arrest occurs, the more severe is the penile defect. Since the incidences of the various types of hypospadias decrease as the defect becomes more severe, one can deduce that penile development is more readily arrested during the late stages.

Congenital chordee, constantly found with the more severe cases, is probably due to retardation in the development of the corpus spongiosum as compared with the cavernous region of the penis, the condition normally occurring in a female. With this hypoplastic fibrous spongiosum, continued growth of the cavernous region would make the caudal curvature more pronounced.

#### ETIOLOGY

A. *Heredity*: The frequently reported occurrence of hypospadias in more than one individual within a family definitely indicates that it can have an hereditary basis. It has been reported as both a dominant<sup>12, 16</sup> and a recessive trait.<sup>31</sup>

The most extensive study of the heredity of hypospadias has been made by Sørensen.<sup>31</sup> A total of 1590 male relatives of 173 individuals with the defect was examined clinically. In 103 cases this included all living male relatives. Familial occurrence of hypospadias was found in 28.1 per cent of the families, with 9.6 per cent of the brothers affected and 1.76 per cent of all male relatives. With the incidence in the population at large being 0.33 per cent, these figures are statistically significant. Concordance was found in 8 of 15 pairs of monozygotic twins and in none of 6 pairs of dizygotic. There was marked intrafamilial variation in the severity of the defect.

A statistical analysis of the data suggested that the most probable mode of heredity was as an autosomal recessive with manifestation varying from 15.4 to 60.1 per cent. If "N" represents the dominant gene for normal penile development and "n" the recessive gene for hypospadias, these conclusions mean that both normal males and females can be "carriers" of hypospadias (Nn), and that the individual with the defect (nn) would have received an n-gene from each parent. It also means that even if an individual should inherit the two genes for hypospadias (nn) the penile defect would actually develop in only 15.4 to 60.1 per cent of such individuals. This reduced manifestation is the result of complex genic and environmental interactions which frequently modify the expression of a single pair of genes.

Since only a single case of hypospadias was found in 71.9 per cent of the families, Sørensen concluded that the defect must be dependent upon exogenous as well as endogenous, or genic factors.



*B. Exogenous factors other than hormones:* It is well known that cleft palate, cleft lip, and other anomalies due to defective closure are caused by an arrest at a critical stage in development, with the embryonic condition consequently retained in the adult. It is also known that, although these anomalies may be hereditary, they can also be produced by maternal virus infection, radiation, cortisone, vitamin deficiencies and other deleterious agents, provided the causative agent is present at the critical time the embryologic process concerned is taking place.<sup>33</sup>

One case of hypospadias following maternal rubella infection has been reported.<sup>27</sup> In a study of 124 cases of hypospadias with adequate pregnancy histories, Sørensen found no evidence of infectious diseases, avitaminosis, somatic or psychic trauma, intoxication, or hemorrhage during pregnancy. However, 9 of 173 hypospadiacs had other congenital defects: deafness, cleft lip, cleft palate, megacolon and anal stricture, club foot, or feeble-mindedness.<sup>31</sup>

Hypospadias has rarely been produced experimentally by agents other than sex hormones. Wilson and Warkany observed the defect in 7 of 15 rats from mothers with vitamin A deficiency.<sup>38</sup> Other genital anomalies, as well as defects of other organs, were also observed. Using X-ray, Russell induced numerous abnormalities in the mouse embryo, the incidence and type depending upon the time of radiation. One case of severe hypospadias, with persistence of the cloaca, was observed following radiation on day 6½.<sup>30</sup> The fact that this abnormality has been observed so rarely may mean that treatment has not been given at the critical time in development. It may also be due to differences in the development of the penis in man and in the common laboratory animals.

*C. Hormonal factors:* Since the urogenital folds fuse in the human male but remain unfused as the labia minora in the female, partial or complete lack of fusion can justifiably be considered a form of intersexuality or feminization. One would expect, then, a close correlation between the severity of hypospadias and the degree of feminization of the other structures such as a bifid, labia-like scrotum and the retention of Müllerian duct derivatives. Of 14 patients examined, Howard reported a normal prostatic utricle in 4 with penile hypospadias, an enlarged utricle in 6 with scrotal and 2 with perineal hypospadias, and the presence of a vagina and uterus in 2 cases of perineal hypospadias.<sup>14</sup> Since an enlarged prostatic utricle rarely produces overt symptoms and since it can easily be overlooked in routine examinations, it probably accompanies hypospadias much more frequently than is reported.

Descent of the testes is believed to be dependent upon androgen secretion. The increased incidence of cryptorchidism in patients with hypospadias has frequently been reported. In a study of 274 cases of hypospadias, Sørensen found that the incidence of cryptorchidism increased with the severity of the penile defect, being 2.0 times that in the population at large in glandular hypospadias, 6.0 times that in penile, 12.7 times in scrotal, and 16.9 times in perineal. The over-all incidence of cryptorchidism in these 274 patients was 5.4 times that in the general population.<sup>31</sup>

If hypospadias is considered a form of feminization, it should be due to a

more or less severe degree of deviation from the normal pattern of sexual differentiation. At the present time there are three hypotheses to explain normal differentiation: (1) the dihormonic, (2) the monohormonic and (3) the anhormonic.

The dihormonic hypothesis, based on a brilliant analysis of the freemartin (the masculinized female twin of a normal male in cattle), was proposed by Lillie in 1917.<sup>17</sup> According to this hypothesis, embryonic gonads produce sex hormones, male or female, depending on the genetic sex of the individual. The embryonic male hormone stimulates differentiation of the external genitalia and the Wolffian duct system in the male direction and inhibits the development of the Müllerian ducts. Conversely, the embryonic female hormone stimulates differentiation of the external genitalia and the Müllerian duct system in the female direction and inhibits the development of the Wolffian ducts. Female pseudohermaphroditism, therefore, would be due to high androgen levels, presumably from hyperactive fetal or maternal adrenal glands; male pseudohermaphroditism, including hypospadias, would be due to excessive maternal estrogen production. This dihormonic hypothesis has been widely adopted by clinicians and has been the stimulus for subsequent investigations in the field of sex differentiation.

As a result of experimental work, the chief supporters of this hypothesis have been Green, Burrill, and Ivy<sup>13</sup> and Burns.<sup>5</sup> Treatment of sexually undifferentiated rat fetuses and opossum pouch-young with androgen resulted in masculinization of the external genitalia of females, whereas treatment with estrogen produced hypospadias in males. Estrogen treatment also resulted in the replacement of the vascular beds of the penis by dense fibrous tissue, possibly homologous to the fibrous cords resulting in chordee in human cases of hypospadias. Internal modifications, usually compatible with the dihormonic hypothesis, were also observed in both species.

The monohormonic theory was proposed by Wiesner, who observed that the growth and differentiation of the penis of male rats castrated at birth were inhibited and that the corpus spongiosum was replaced with connective tissue. This inhibition was prevented by the administration of androgen. Female rats ovariectomized at birth developed normally. Male hormone administered to females immediately after birth caused the differentiation of a typical corpus spongiosum even when estrogen was given simultaneously. He concluded that male hormone was necessary for the development of male genital organs, whereas female hormone was not necessary for female differentiation.<sup>36</sup> According to this monohormonic hypothesis, hypospadias in man would be due to inadequate amounts of androgen rather than to the feminizing influence of estrogen. Varying degrees of hypospadias and intersexuality would occur depending upon the degree, the time, and the duration of the androgen deficiency.

Recently technics have been devised for castrating placental embryos by irradiation or by surgery and the results support the monohormonic hypothesis.<sup>28, 15</sup> The internal and external genital organs of female rabbits, gonadectomized prior to sexual differentiation, developed normally, whereas in castrated

males the urogenital sinus and external genitalia were like those of females, and, as in the normal female, the Wolffian ducts regressed and the Müllerian ducts persisted and differentiated. If castration of the male fetus was done during the course of sex differentiation the condition of the external genitalia varied, being typically female, hypospadiac, or typically male, depending upon the time of castration. Feminization of the external genitalia and atrophy of the Wolffian duct system could be prevented by administering testosterone propionate.

Moore, the chief proponent of the anohormonic hypothesis, treated opossum pouch-young with sex hormones. In both sexes, androgen stimulated phallic differentiation in the male direction. Estrogen also stimulated growth of the phallus but did not produce masculinization. Internally, in both sexes, Müllerian and Wolffian ducts were stimulated by both male and female sex hormones. On the basis of these "paradoxical" effects Moore proposed the anohormonic hypothesis:<sup>21</sup> "Sexual differentiation involving glands, as well as ducts, phallus, etc., is under the control of genetic sex-determining factors and not controlled by gonad secreted hormones."

This hypothesis was supported by the results obtained after gonadectomizing pouch-stage opossums, in which the reproductive organs differentiated normally according to the genetic sex of the animal. Moore stated:<sup>22</sup> "Hermaphroditic conditions, such as are found in the human organism, are not believed to rest upon an hormonal basis for their establishment."

Moore's conclusions have been criticized by proponents of the other hypotheses, who suggest that the "paradoxical" effects were due to the tremendous dosages of hormones employed, and that normal sexual differentiation occurred in his castrated males because the accessory genital structures had already been influenced by the embryonic male hormone at the time of castration.

Considering all of the experimental results, but particularly the recent results of early embryonic gonadectomy, there appears to be more evidence to support the monohormonic hypothesis of sex differentiation. However, the generalization that sex differentiation in all species is dependent upon the presence or absence of an embryonic male hormone cannot justifiably be made at the present time.

Female pseudohermaphroditism in the human being can be explained by both the monohormonic and dihormonic hypotheses on the basis of elevated androgen levels. It is well known that androgen from hyperactive adrenal glands can masculinize the human female fetus.

According to the monohormonic hypothesis, male pseudohermaphroditism, including hypospadias, is due to inadequate androgen secretion at critical developmental stages rather than to elevated estrogen levels as postulated by the dihormonic adherents. In a study of 124 human pregnancies resulting in hypospadiac sons, Sørensen found no indications of abnormal endocrine function in the mother. High estrogen levels, however, could result in lack of masculinization by inhibiting the fetal pituitary and thereby indirectly reducing androgen secretion.

The occurrence of individuals with male type chromosomal characteristics in cases of "ovarian agenesis" gives strong support to the monohormonic hy-

pothesis.<sup>37</sup> If the gonads of a genetic male fetus failed to develop and therefore produced no androgen, one would expect the internal and external accessory genital organs to differentiate in the female direction and that such individuals would be classified as females without ovaries.

#### SURGICAL CORRECTION

In reviewing the surgical literature on the repair of the hypospadiac deformity, one is impressed by the great diversity of thought reflected in the wide variety of procedures which have been recommended. An evaluation of these various procedures is based on how near their final results are to the normal in regard to appearance and function and also on the number of operative procedures required to attain this end. Ideally, the reconstructed penis should be similar to the normal in color, texture, and contour. The urethra should be hairless and the functions of micturition and coitus unhampered by fistulas, strictures, chordee, or unnecessary hair. That operative procedure which can consistently give normal appearance and function in the fewest operative stages should be considered the preferable one. With these general criteria in mind we will examine the basic approaches to this problem and give the rationale for the method which we have selected, together with salient points in technic.

Correction of this deformity is warranted because of the abnormal appearance and function of the organ in regard to both its urologic and genital duties. In the child normal control of the urinary stream may be compromised in the erect position and in the adult, in addition, normal coitus may be impossible because the chordee frequently becomes much more pronounced with erection. Surgery is therefore carried out prior to school age to restore normal appearance and function before these embarrassments arise. At that age the organ is of satisfactory size to facilitate the procedure. Deference of the repair until later years, however, does not appear to be associated with any limitation of growth.

In the surgical correction of the hypospadiac deformity one is confronted with two distinct problems: (1) the correction of the chordee, and (2) the reconstruction of the urethra. In the correction of the chordee the fibrous sheath which encompasses the ventral half of the penile shaft is meticulously dissected free of the surrounding tissues and resected in its entirety. As a result, the penis is freed from marked ventroflexion and assumes a normal straight position. Consequently, however, another defect is created, a large area on the ventral surface of the penile shaft being uncovered. Therefore, tissue must be supplied in sufficient quantity not only to close this ventral defect, but also to carry out the eventual reconstruction of the distal urethra.

Since there is general unanimity of opinion on the means of correction of the chordee, the problem which confronts us is the selection of the most appropriate procedure for the closure of the ventral defect and reconstruction of the urethra. In this regard we must consider what tissue qualities are most desirable and what procedures should be followed in the light of sound surgical principles in order to select an approach which is most likely to give constant success with the fewest operative procedures possible. The desirable qualities which we seek in

the tissue to be used in this reconstruction are thinness, elasticity, absence of hair follicles, a reliable blood supply in the case of pedicled flaps, and satisfactory quantity. In general there are three sources from which tissue is obtained for this reconstructive work: (1) the dorsal prepuce, (2) the scrotum, and (3) more distant sources of skin or mucous membrane. The first two are utilized as pedicled flaps and the distant tissue as split thickness or full thickness free grafts.

Because of its desirable qualities of thinness, absence of hair follicles, elasticity, excellent and reliable blood supply, and generous quantity, the prepuce has been utilized from earliest times in reconstructing congenital defects of the penis.<sup>34</sup> Scrotal skin has been used as a covering of the ventral aspect of the penis,<sup>2</sup> in the reconstruction of the urethra,<sup>4, 29</sup> or both,<sup>18</sup> but has the disadvantages of being thick and hair bearing, introducing the complications of folliculitis when used on the penile surface and of calculi formation<sup>35</sup> when used in reconstruction of the urethra. In addition to these two distinct handicaps, its use requires one or more extra operative procedures.

The use of tissue from a distance in the form of free grafts of skin<sup>28</sup> or mucous membrane<sup>20</sup> introduces certain possibilities of failure which one would prefer to avoid. The efficacy of a free graft depends upon its inherent qualities and its survival. Full thickness grafts may be lacking in the desired elasticity, resulting in ventroflexion of the penis, especially with erections, or they may contain unsuspected hair follicles. The survival of a free graft is directly related to the hemostasis secured in the recipient bed. After the careful dissection of the sclerosed corpus spongiosum the bed is an oozing one and hemostasis difficult to obtain save by the use of electrocautery. In addition, further bleeding may occur with erections in the immediate postoperative period. A comparatively small hematoma may result in a slough of the overlying free graft, leading to serious stricture formation. Split thickness grafts also have the decided handicap of contracture. Because of these complications, which are not at all infrequent in the use of free grafts, we have avoided their use, especially since no concomitant advantages are to be obtained therefrom. Tubed pedicled flaps bringing in tissue from a distance have not been found necessary except in extensive reconstructive procedures. The use of homogenous grafts such as urethra, appendix, and vein is, at the present time, of historic interest only.

The most desirable tissue to be used in the reconstructive phase of hypospadiac surgery is, in our opinion, that of the dorsal prepuce, both because of its particularly satisfactory qualities and because of the surgical principles involved. Having made the decision to use preputial skin, we must decide next how it is to be used to give the best opportunity for success. Since it is to be transferred to the ventral aspect of the penis in pedicled flaps, careful examination of its blood supply is warranted.

A preliminary study involving plastic perfusion of the iliac and femoral vessels of stillborns, followed by digestion of the soft tissue with sodium hydroxide, carried out in our laboratory, indicates that the greater part of the blood supply of the prepuce is supplied by the terminal branches of the external



pubdental artery. The dorsalis penis branch of the internal pudendal artery appears to be in a deeper plane contributing little to the preputial blood supply. Since the vessels of the dorsal integument and prepuce course distally along the penis in a subcutaneous position, it is obvious that this vascular pattern must be kept always in mind in planning flaps in this area. They should be based proximally to take advantage of the blood supply unless the length to width ratio is small. In general, it is unwise to elevate a pedicled flap of a length more than one and one-half times its width without previous delay. Flaps based distally<sup>26</sup> must be limited in length and transverse incisions<sup>11</sup> should be avoided. Long flaps, even if based proximally, may suffer slough distally, especially if overly compressed by edema. It is also to be borne in mind that the dorsal skin of the penile shaft is frequently hair bearing and, for this reason, less suitable for urethral construction.<sup>9</sup>

By elevating the entire preputial skin and dividing it along the middorsal line, it can be rotated ventrally in two flaps, with minimal interference to its blood supply.<sup>6</sup> The preputial skin is transferred to the midventral area, where it is best situated for urethral repair. Button-holing the preputial skin to accept the glans penis<sup>23</sup> results in a less satisfactory arrangement of tissue for the ensuing reconstructive procedure than complete midline division.

The reconstruction of the urethra can be carried out either partially with an incomplete lining,<sup>10, 3</sup> or completely. Partial reconstruction by advancing adjacent tissue over a strip of skin is attended by a line of scar tissue extending through the full thickness of the ventral wall of the urethra along its entire reconstructed length, together with a broad band of scar epithelium which follows the healing of the infected granulating urethral surface.<sup>24</sup> This may be associated with deficiencies in growth and later prove a severe handicap in adulthood, producing ventroflexion with erections. With complete reconstruction of the urethra, the lining and surface covering are present in their entirety. Superimposition of the suture lines is avoided,<sup>8</sup> resulting in two linear scars which remain more elastic and pliable as a result of their support by underlying normal tissue.

#### OPERATIVE PROCEDURE

Having decided upon the general plan of action we must next consider in detail the operative procedure. This is essentially a reconstructive problem and demands the most meticulous atraumatic technic. It must be kept in mind that these delicate tissues can be fatally injured by inconsiderate manipulation and the careful planning of the procedure thereby rendered unproductive.

A. *Correction of the chordee:* An annular incision is made just proximal to the junction of the preputial skin with that of the glans penis after introducing a catheter through the urethra into the bladder (fig. 2A). The fibrous band representing the sclerosed corpus spongiosum is meticulously dissected free of the overlying integument and urethra and the underlying corpora cavernosa. The penis then straightens out, leaving a large ventral defect (fig. 2B). The dorsal prepuce is divided along the midline and rotated ventrally in two proximally based flaps (fig. 2C). A vertical mattress suture passing through the remainder



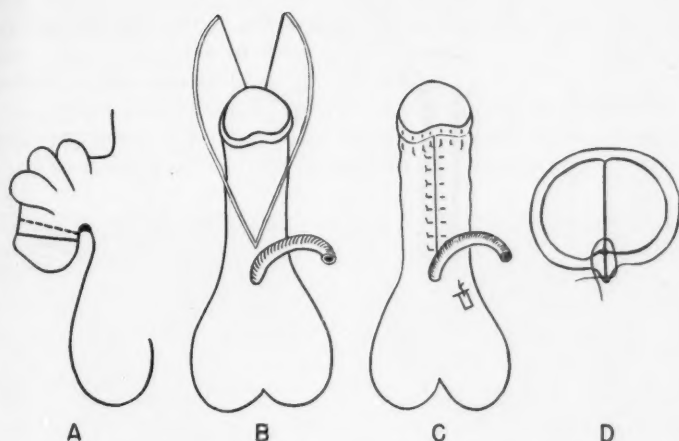


FIG. 2. Correction of the chordee and rotation of dorsal hood to ventral aspect of penis (see explanation in text).

of the fibrous band extending between the corpora cavernosa is used to secure the flaps in the midventral line (fig. 2D).

A drain or catheter attached to low pressure suction is introduced into the base of the dissected wound and the penis dressed in the erect position with light pressure. On the tenth or twelfth postoperative day, the urethral catheter is removed and the patient discharged from the hospital with the penis freed of the chordee and the urethral meatus usually situated more proximally than before the operation.

Hematoma formation is the most usual complication. It can be avoided by securing meticulous hemostasis with the electrocautery, adequate drainage, and by the application of a firm pressure dressing.

**B. Reconstruction of the urethra:** After complete healing of the operative site and disappearance of edema, which usually requires several months, the distal urethra is reconstructed. A posterior urethrostomy is carried out to divert the urinary stream and a plastic tube with multiple perforations along the site of reconstruction is introduced for irrigation. Short broad-based flaps are elevated along either side of the midline in the previously transplanted preputial skin (fig. 3A). These flaps are of unequal length and are joined to one side of the midline by horizontal mattress sutures of fine chromic catgut (fig. 3B). The wound margin on the side of the shorter urethral flap is then elevated and approximated on the opposite side of the midline with vertical mattress sutures secured to the base of the longer underlying flap (fig. 3C). Buried sutures are not used in order to avoid foreign body reaction (fig. 3D).

A drain or low pressure suction catheter is introduced through a stab wound into the most proximal extent of the wound, the irrigating tube is connected to straight drainage as is the catheter in the bladder, both emerging through the proximal urethrostomy.

Following this stage of the operative repair there is oozing of blood and serum

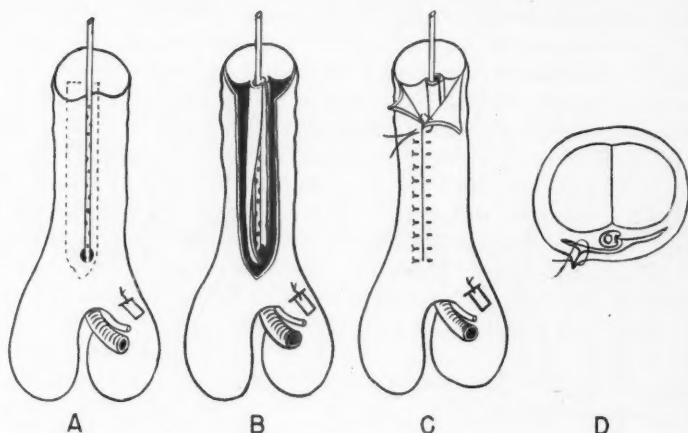


FIG. 3. Reconstruction of urethra over perforated plastic tube after posterior urethrostomy (see explanation in text).

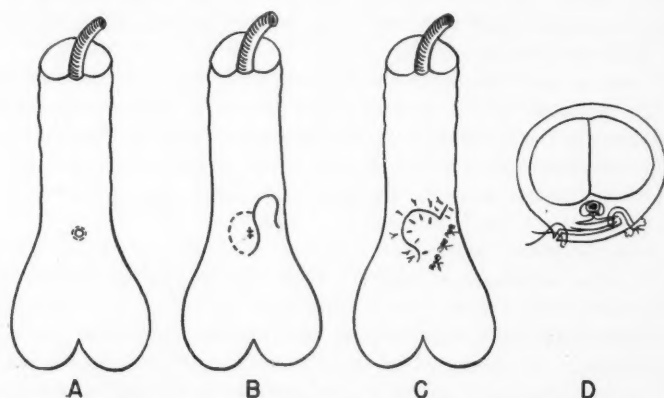


FIG. 4. Repair of urethral fistula (see explanation in text)

into the urethral lumen. This culture medium may be soon infected by bacteria streaming in through the urethral meatus. A defect in the urethral suture line may soon be found or produced and the infection may spread to the limits of the dissection especially if hematomas have formed. If drainage is inadequate abscess formation may take place with perforation through the overlying integument or suture line with resultant fistula formation. In order to avoid this undesirable sequence of events, a plastic tube of small caliber (small plastic feeding tube) with multiple small perforations along the extent of the urethral reconstruction is introduced passing out of the urethra proximally through the urethrostomy and attached to straight drainage. Very slow drip irrigation with saline-penicillin-streptomycin solution is carried out through the plastic tube at

first constantly and then intermittently for several days. The catheter in the bladder is removed on the tenth or twelfth postoperative day following which the posterior urethrostomy closes spontaneously.

In the correction of glandular hypospadias without chordee, because of voiding difficulties, a short ventral flap based distally is sutured to the margins of the groove in the glans penis and the dorsal hood rotated ventrally as a bipedieled

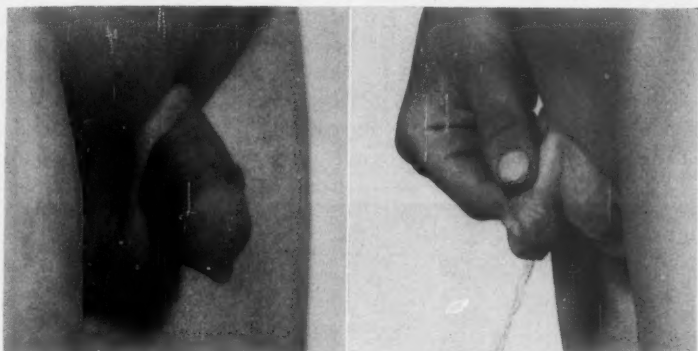


FIG. 5. J. S., aged 9. The urethral meatus was situated at the junction of the glans and shaft, the dorsal prepuce was redundant, but no chordee was present with erections. With voiding the stream was directed inferiorly with poor control. Following a posterior urethrostomy the ventral floor of the distal urethra was reconstructed by a flap with its distally placed base just proximal to the urethral meatus. It was sutured along both sides of the groove of the ventral aspect of the glans. The redundant dorsal hood was carried ventrally passing the glans through a slit. This represents a case of glandular hypospadias with voiding difficulties repaired in one stage.

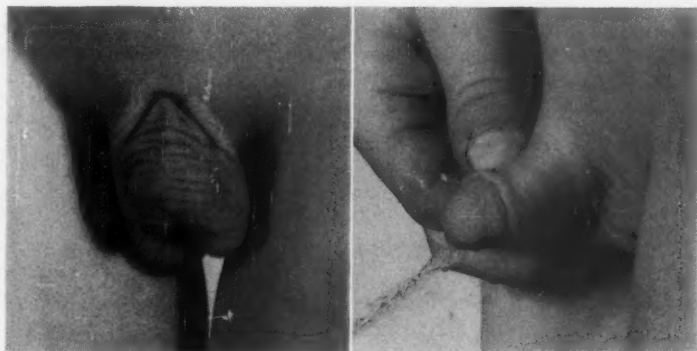


FIG. 6. F. C., aged 6. The urethral meatus was situated at the junction of shaft and scrotum, the chordee extreme, the dorsal hood redundant, and both testicles present in the bifid scrotum. In this, one of our earlier cases, the glans penis was introduced through a slot in the ventrally rotated dorsal prepuce. An extra operative procedure was required to correct a redundant fold. The routine second stage was carried out as a third procedure. This case illustrates the fact that an unsatisfactory distribution of skin may accompany the ventral rotation of the prepuce as a single flap, giving rise to subsequent difficulty in urethral reconstruction.

flap after posterior urethrostomy. If chordee is present, a routine two stage procedure is carried out

Examples of the correction of varying degrees of hypospadiac deformity in accordance with these principles can be seen in figures 5-10.

C. *Fistula repair*: A catheter is introduced into the bladder through the reconstructed urethral meatus. An annular incision is carried around the margin of the fistula and the urethral wall is approximated with horizontal mattress sutures of fine chromic catgut (fig. 4A). If any subcutaneous tissue can be made available, such as scrotal tissue, it can be carried across the defect in one direction and a small surface flap<sup>2</sup> rotated in the other, after the removal of a circular area of superficial skin about the fistula (fig. 4B and C). The subcutaneous flap is anchored by mattress sutures tied over a pledget of cotton just lateral to the base of the cutaneous flap which extends in the opposite direction (fig. 4D). In

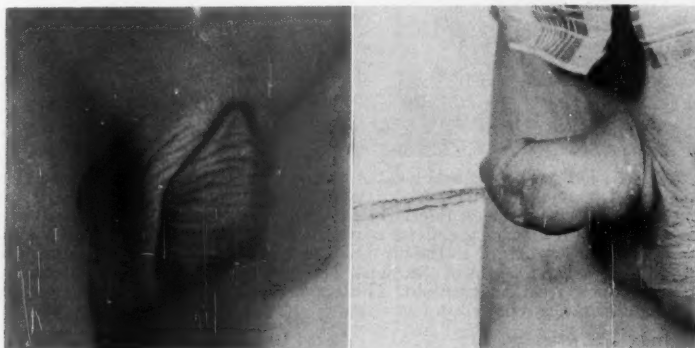


FIG. 7. J. L., aged 9. The urethral meatus was situated at the junction of the shaft, glans, and scrotum. The chordee was severe, the sclerosed corpus spongiosum palpable, and the dorsal prepuce redundant. The usual two stage procedure was carried out at a 2 month interval.

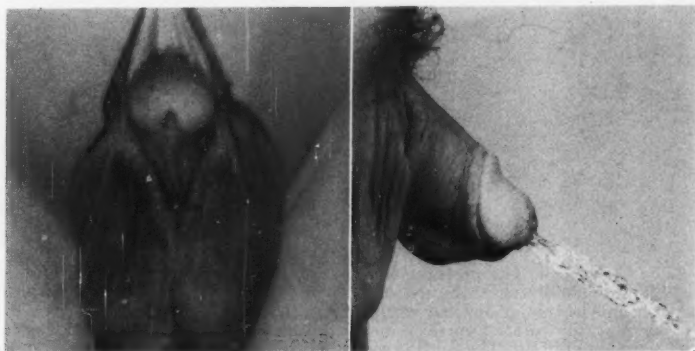


FIG. 8. T. R., aged 12. The urethral meatus was located at the junction of shaft and scrotum. There was a marked chordee, redundant dorsal hood, and palpable corpus spongiosum. This defect was corrected in two stages 3 months apart.



FIG. 9. R. C., aged 8. This patient was first seen after two operative procedures done elsewhere. Examination revealed a marked chordee, redundant dorsal hood, ventral scarring, and the urethral meatus near the base of the penile shaft. A two stage procedure was carried out with a 9 month interval for school.

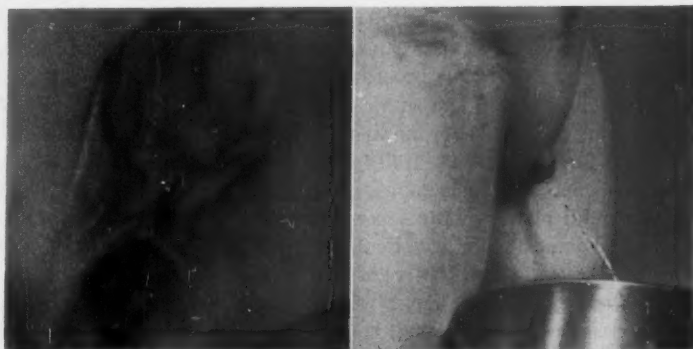


FIG. 10. C. M., aged 4. The patient appeared to be a normal female at birth but subsequent surgery revealed two testicles (biopsy) and complete absence of uterus, tubes, and ovaries. Following a plastic procedure elsewhere to elongate the penis, the distal urethra was reconstructed as a first stage procedure here followed in 1 month by suprapubic cystostomy, excision of the vagina, and anastomosis of the urethra. Subsequently the testes were brought down into the labia majora by our urologic consultant. This male pseudohermaphrodite was brought up from infancy as a boy and was grateful for the change in voiding posture.

this fashion a layered closure is obtained without the burial of suture material and without superimposition of suture lines. The introduction of a bactericidal or bacteriostatic agent such as Furacin or a related product alongside the urethral catheter at regular intervals is helpful in combating infection. The catheter is removed along with all sutures in 10 days.

#### SUMMARY

Hypospadias in man appears to be due to developmental arrest. Few, if any, cases are known to be caused by such exogenous agents as maternal infections,

avitaminosis, etc. Because of the high incidence of associated genital anomalies (cryptorchidism, bifid scrotum, enlarged prostatic utricle) many cases of hypospadias are probably due to disturbances in sex differentiation. Considering the experimental evidence in addition to clinical observations, the most likely cause of this abnormal differentiation would be inadequate fetal androgen production at a critical stage in development, rather than to the frequently postulated feminizing influence of excessive amounts of estrogen.

In about 25 per cent of the cases hypospadias appears to be inherited, probably as a recessive trait with reduced and variable manifestation. This does not rule out the possibility of a dominant form of inheritance in some families. Because of the complexity of the development of the penis, it is not unlikely that several different genes are involved. Normal development probably depends upon the proper functioning of the fetal pituitary, fetal testis and the proper response or reactivity of the target organ, the urogenital folds, at a critical time in development. A gene, or any other agent, interfering with the function of one of the endocrine organs involved or interfering with the reactivity of the target organ could produce the defect.

The ultimate goal in the surgical correction of the hypospadiac deformity is the consistent attainment of an organ of as normal appearance and function as possible in the fewest operative procedures. After taking into consideration the tissue qualities desired and the surgical principles involved, we have outlined the reasons for our preference for the tissue of the dorsal prepuce and the rationale for its use as pedicled flaps. Points in technic such as the avoidance of buried suture material and the superimposition of suture lines are pointed out. In addition to careful planning, the success of each case depends upon two other factors of equal importance: a meticulous atraumatic technic and painstaking after care. One must be constantly on the alert that a tight dressing may not occlude the blood supply to a flap, a wet dressing produce extensive maceration or a loose dressing allow edema and hematoma formation. With good planning, meticulous technic and watchful after care, the results are highly satisfactory to both patient and surgeon. The final result is a penis which is readily extensible, of normal color, contour, and texture, with its urethra free of hairs and requiring no postoperative dilatations. To be sure, the urethral meatus is situated at the junction of the glans and shaft rather than at the apex of the glans, but otherwise there is little to distinguish the postoperative appearance and function in these patients from the normal.

*Medical College of South Carolina  
Charleston, South Carolina*

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## LOWER ESOPHAGEAL WEB: AN OBSCURE CAUSE OF DYSPHAGIA

CHARLES V. DEMONG, M.D., JOHN B. GROW, M.D.

*Denver, Colo.*

Templeton<sup>7</sup> in 1944, described a ring-like narrowing in the lower esophagus which he thought had no clinical significance. Several recent reports<sup>3, 4, 6</sup> however, have shown that such rings may be a cause of dysphagia. The dysphagia in several of the reported cases was severe enough to require surgical treatment. We are reporting the case records of 2 patients with severe dysphagia, each of whom had a ring or web in the lower esophagus in addition to an esophageal hiatus hernia of significant size.

The ring, as seen on X-ray examination, is a sharply defined indentation 2 to 6 millimeters in width across the long axis of the esophagus, 3 to 6 centimeters above the cardioesophageal junction (fig. 1). The diameter of the lumen in the ring varies from 3 to 38 millimeters. It is usually not seen on examination in the upright position, and may not be seen on fluoroscopic examination. It is shown best on spot films taken with the esophagus fully distended with barium (fig. 2). A barium filled capsule or barium coated food, if large enough, may be seen to obstruct the lumen of the ring. Dilation of the esophagus proximal to the ring has not been noticed. Similar rings have been noted in patients without dysphagia, the frequency of this finding being 1 to 6 per cent of routine examinations.<sup>5, 6</sup> Esophagoscopy was performed in 26 of the reported cases, with normal findings being described in 25. In one case, the 3 mm. opening in the web was noted.

Various ideas concerning the anatomic and pathologic nature of the ring have been proposed. Of the 21 patients with symptomatic rings, observed by Schatzke and Gary,<sup>6</sup> only one required surgical treatment. The narrowing was found to be at the gastric-esophageal junction with no abnormality of the esophageal wall. Excised tissue was described as being squamous epithelium with marked hyperkeratosis. They believe that the ring is due to a herniated gastroesophageal junction. Kramer<sup>5</sup> concluded that the ring is due to an overactive lower esophageal sphincter muscle. In his one patient requiring surgical treatment, hypertrophy of the muscle with normal squamous epithelial covering was described. Budgen and Delmonico<sup>2</sup> believe that the ring is of congenital origin, and that symptoms may first appear in older people because of the changes in the membrane produced by trauma and inflammation. Partial excision of the web was performed by them in 2 patients. The excised tissue was composed of hyperplastic squamous epithelium, submucosa and muscularis, similar to the normal esophageal wall. Allison<sup>1</sup> classified these webs as a type of short fibrous stricture resulting from coalescence of superficial ulcers with attenuation of the granulation tissue by movement, and eventual replacement by fibrous tissue and an epithelial overgrowth.

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FIG. 1. Esophogram in 58 year old man who had had several episodes of dysphagia on swallowing large pieces of meat.



FIG. 2A

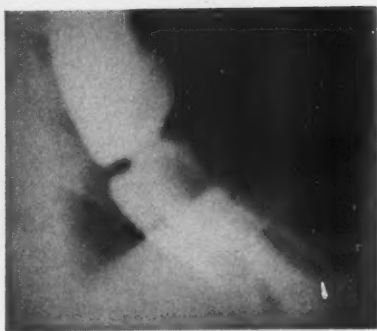


FIG. 2B

FIG. 2. A 60 year old man with several episodes of dysphagia. A. Esophogram without lower part distended; ring not visible. B. Esophogram with lower segment distended showing the ring.

## CASE REPORTS

Case 1. M. L., a 56 year old man, was first seen by us July 12, 1956, with the complaint of dysphagia for the past 11 years. The dysphagia at first was intermittent in character and had occurred most often when eating meat. The sensation of obstruction was felt in the lower portion of the chest and could be relieved by vomiting or washing food through with liquids. He experienced heartburn quite frequently. He had had several X-ray examinations of the esophagus and had been told that his swallowing difficulty was due to cardiospasm. Esophagoscopy had been performed 3 or 4 times to "stretch the lower esophagus." In 1947 a diagnosis of esophageal hiatus hernia was made after another X-ray examination, and repair was performed through a transthoracic incision. We were not able to obtain any of these X-rays. No improvement in swallowing occurred after the operation. For 2 months preceding his first visit to us, he had restricted his diet to liquids, and had lost 20 pounds in weight. X-ray study of the esophagus showed recurrence of the esophageal hiatus hernia. There was no obstruction of the passage of barium from the esophagus to the stomach. There was a constant short narrowed area in the lower esophagus, the lower limit of which was not well defined as the esophagus below this narrowing was never fully distended (fig. 3). There was no dilation of the esophagus above the narrowing. Esophagoscopy was not performed. On July 18, 1956, operation was performed through a right upper abdominal vertical incision. The lower end of the esophagus was mobilized and on palpation, it felt thicker than normal. A finger, introduced into the lower esophagus through an incision in the anterior stomach wall, encountered a leathery feeling, pliable obstruction about 3 to 4 centimeters

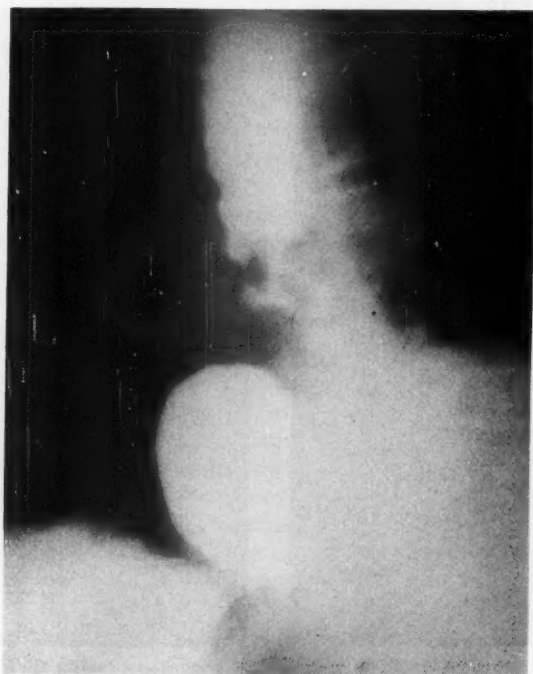


FIG. 3. Case 1. Constant narrowing in lower esophagus. Lower limit of ring not well defined as lower esophagus not fully distended. A hiatus hernia was present but is not seen on this view.

above the cardioesophageal junction. After making a longitudinal incision in the esophagus over this area, the obstruction was seen to be due to a membrane 3 millimeters in thickness with a central opening of 8 millimeters in diameter. The membrane was excised and the mucosal defect closed with interrupted sutures of silk. The mucosa of the esophagus in the region of the membrane appeared normal. The incisions in the esophagus and stomach were closed in layers, and repair of the hiatal hernia was carried out, uniting the crura of the diaphragm behind the esophagus. The esophagus was reattached to the margins of the hiatus and to the phrenicoesophageal membrane by interrupted silk sutures. The fundus of the stomach was fixed to the lower surface of the diaphragm with several interrupted silk sutures.

Postoperatively, there was an infection at the upper end of the wound. Drainage continued through a sinus tract in the region for several months, and eventually exploration of the tract revealed a necrotic xiphoid process with a small abscess cavity. The patient was last seen March 15, 1957. He has been able to eat all types of food without difficulty and has had no recurrence of heartburn. Microscopic study of the membrane showed mild hyperplasia of the squamous epithelium, mild edema in the submucosa, and absence of muscle in the lamina propria (fig. 4).

Case 2. E. D., a 56 year old woman, was first seen Dec. 10, 1954 with complaints of intermittent dysphagia and pyrosis for the preceding 4 years. X-ray examination in 1952 was reported as showing an esophageal hiatus hernia. Repair of the hernia was carried out

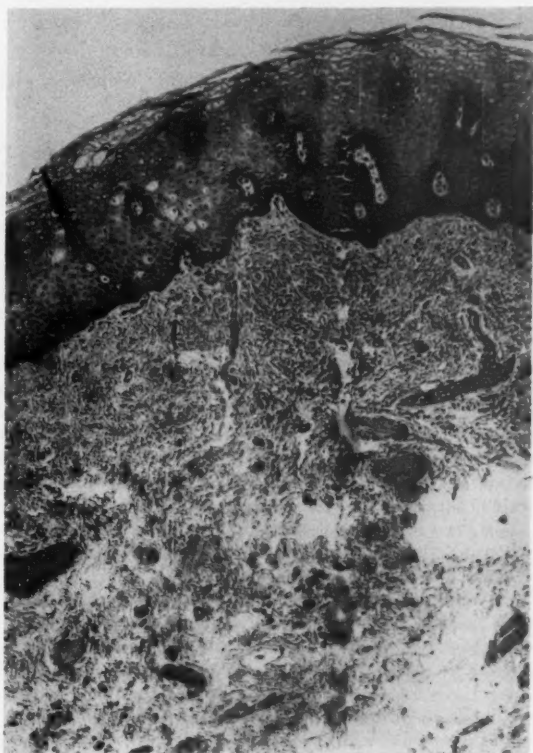


FIG. 4. Case 1. Mild hyperplasia of squamous epithelia, slight submucosal edema and absence of muscle in lamina propria.



FIG. 5. Case 2. Ring-like, constant narrowing in lower esophagus with eccentrically placed lumen.

through a transthoracic incision in 1952. We were not able to obtain these X-rays. She had no improvement in her symptoms following operation and continued to eat only liquids and very soft foods. She had eaten no meat for the past 5 years. Esophagoscopy on December 14, revealed moderate esophagitis in the lower third without ulceration. There was some resistance to the passage of the 10 mm. diameter esophagoscope into the stomach. She was not seen again until July, 1956, and she again said that she was able to eat only liquid and very soft foods. An esophogram revealed an esophageal hiatus hernia and constant web-like deformity in the lower portion of the esophagus which did not obstruct the flow of barium. The lumen of the obstructing area was eccentrically placed (fig. 5). At operation through a left transthoracic approach on August 8, the esophagus was mobilized. A short incision was made in the diaphragm and a finger introduced into the esophagus through an opening in the anterior wall of the stomach. There was obstruction to the finger 4 centimeters above the cardioesophageal junction. A longitudinal incision in the esophagus was made over this area and a membranous structure 3 millimeters in thickness was seen with an eccentrically placed opening 8 millimeters in diameter. The membrane was excised and the mucosal defect closed with interrupted sutures of fine silk. The mucosa in this region appeared normal, and the wall of the esophagus was of normal thickness. Repair of the hiatal hernia was carried out as in case 1. Water-seal intercostal drainage tubes were inserted after repairing the defect in the diaphragm. The wound in the chest wall was closed in layers.

Postoperatively, there was no undue elevation of temperature. She complained of dysphagia when eating soft foods. X-ray examination showed a partial obstruction in the lower esophagus. On esophagoscopy on August 29, rigidity of the wall of the lower esophagus was noted. The 10 mm. esophagoscope was passed into the stomach with some resistance. It was our impression that the narrowing was due to an extrinsic process, such as mediastinal inflammatory process. There was no evident widening of the mediastinum on X-ray. Antibiotic therapy was continued with some improvement in her ability to swallow. Esophagoscopy was repeated on September 5, and the 10 mm. diameter instrument encountered only slight resistance on passage into the stomach. On Sept. 10, 1956, esophageal





FIG. 6. Case 2. Mild hyperplasia of squamous epithelium, mild inflammatory changes and edema in submucosa.

dilation was carried out passing graduated dilators through No. 43F. over a previously swallowed string. She was last seen in our office on March 15, 1957 and stated that she was able to eat all types of food without difficulty and had no heartburn. Microscopic examination of the excised web revealed mild hyperplasia of the squamous epithelium and mild inflammatory changes and edema in the submucosa (fig. 6).

#### DISCUSSION

Dysphagia in a patient with an esophageal hiatus hernia may be due to the esophagitis which frequently is present as a result of the hernia causing incompetency of the cardioesophageal junction. The esophagitis and dysphagia will disappear following satisfactory repair of the hernia. One should be certain that a coexisting web is not present as a cause for the dysphagia by obtaining X-rays of the lower esophagus fully distended with barium. As in our cases, repair of the hernia without excision of an associated web will result in persistence of the dysphagia. We were unable to obtain the esophograms made in our patients prior to their original operations. The web in each case was either not demon-

strated, or, if seen, no significance was attached to its presence. We believe, with Allison, that these webs are a type of stricture produced as a result of ulceration, involving only the mucosal lining of the esophagus. This type of ulceration may be present in esophagitis, and the latter may occur in the absence of an esophageal hiatus hernia. A lower esophageal web, therefore, may occur in patients with or without an esophageal hiatus hernia.

The clinical symptoms and roentgenologic findings are the same in lower esophageal web, contractile esophageal ring, and lower esophageal ring, and it is possible that these terms are being used to describe one pathologic condition. It would seem that the designation "esophageal web," best describes the gross and histologic findings in the few patients who have required surgical treatment.

Most patients with symptomatic esophageal rings or webs can avoid dysphagia by chewing their food more thoroughly and by learning to swallow only small pieces of the coarse foods. If dilation of the narrowed area does not afford relief of symptoms, excision of the obstructing web has proved to be an effective procedure.

#### SUMMARY AND CONCLUSIONS

Case histories of 2 patients with dysphagia, esophageal web, and esophageal hiatus hernia have been presented. In each case, the web was either not seen; or if seen was not considered significant, and dysphagia persisted following repair of the hernia. Subsequently, in each case, the web was excised and a recurrent hernia repaired, followed by complete disappearance of the dysphagia. In patients with esophageal hiatus hernia who have dysphagia, the possibility of the presence of an associated esophageal web must be determined by obtaining esophagrams showing the lower esophagus fully distended with barium.

3705 E. Colfax Ave.  
Denver, Colorado

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## CURRENT CONCEPTS OF TREATMENT OF PERIPHERAL VASCULAR OCCLUSIVE DISEASE

EDWARD R. MUNNELL, M.D., AUSTIN H. BELL, M.D.

Oklahoma City, Okla.

Each year many more thousands of people are living into the older age decades. As a result of this, degenerative diseases and especially the problem of peripheral vascular occlusive disease, by necessity, have received renewed emphasis. Re-established interest in the early diagnosis and an awareness of newer treatment methods seems timely. Therefore, what is the current management of the patient with inadequate peripheral arterial blood flow?

### CLINICAL STUDY

*History:* In peripheral vascular occlusive problems the most important element in the history is pain. The patient's pain does not suggest poor blood flow to him, so he usually seeks help from the general practitioner or internist, or in some cases the orthopedic surgeon, gynecologist or urologist. Characteristically, the claudication is slowly progressive and intermittent. Arteriospasm rather than occlusion more commonly causes subjective coldness or hyperesthesia to temperature.

*Physical Examination:* A general inspection of the patient can give an immediate impression of degenerative disease involving the arterial system. More specifically, the involved part often has pale, atrophic skin. Elevation causes blanching and dependency will produce a marked reactive hyperemia. Unequal skin temperatures are appraised and can be recorded with a thermocouple if desired. The simplest and foremost finding, however, is the absence of a pulse or a difference of magnitude of comparable pulses.

*Adjuncts; X-Ray, Oscillometry:* These studies are of consequence and confirm or delineate more exactly the nature of the peripheral arterial occlusion. X-Rays can show calcified vessels, aneurysmal soft tissue displacement or the osteoporosis of chronic arterial insufficiency. An oscillometer, which is a device for measuring pulsatile phenomenon, provides a rather crude method of following the course of improvement or deterioration of the circulation in an extremity.

*Arteriography:* Arteriography is an aid one consistently uses in the management of these diseases.<sup>7</sup> This study might be called a vascular map as it shows the location of blockage, degree of narrowing, and the location of collateral or detour routes. Technically, arteriography requires the injection of contrast media into the circulation at a level that will define the diseased vascular tree. Because of a distinct risk,<sup>10</sup> arteriography should be used with clear-cut indications.

*Sympathetic Block:* This is the final adjunct of an adequate clinical evaluation

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*Surgical categories of occlusive disease*

1. Dead Tissue
2. Segmental Occlusion with Diffuse Arteriosclerosis
3. "Pure" Segmental Occlusion

FIG. 1. Classification of occlusive arterial disease that is useful in the surgical management of these problems.

of these patients. It is performed when studies indicate the probability of diffuse arteriosclerosis. The subjective response and skin temperature changes following the block are noted. After a complete study, the patient's occlusive arterial problem can be placed in a category.

## SURGICAL CATEGORIES

Surgically speaking, occlusive arterial disease may be classed as (1) dead tissue, (2) segmental occlusion with diffuse arteriosclerosis, and (3) so-called "pure" segmental occlusion (fig. 1). In advanced cases, (the first group) progression of arterial insufficiency reaches the stage in which the presenting problem that must be dealt with is tissue necrosis. The second category, diffuse arteriosclerosis, with partial or complete segmental occlusion, is found by arteriography. Sympathetic block is essential in the diagnostic management of this group. Finally, a large percentage of these patients have demonstrable areas of complete blockage of their arterial tree with reasonably normal proximal and distal vessels. Study of the arteriogram, as one would study a road map, is mandatory in the handling of this group.

## SURGICAL PROCEDURES

At this point, a so-called *treatment directing diagnosis* has been established and the vascular surgeon can proceed with individualized management. He has the following methods to use: (1) incision and drainage, (2) amputation, (3) sympathectomy, and (4) direct approach on the occluded vessel, using endarterectomy alone or with a vascular graft.

*Amputation and Drainage:* In far advanced cases of arterial occlusion, infected areas are managed by incision and drainage and dead tissue is removed by debridement or amputation by well established methods. Patients who require these methods are less commonly seen today, probably due to the increased awareness of occlusive arterial disease and early diagnosis.

*Sympathectomy:* Patients with diffuse arteriosclerosis and complete or incomplete segmental blockage, as demonstrated by arteriography and with a satisfactory response to sympathetic block, should have lumbar sympathectomy.<sup>5, 6</sup> Drugs that induce vasodilatation are well known and the experiences of most suggest that they are of little value in occlusive arterial disease and should be reserved for vasospastic conditions. The use of sympathectomy is illustrated by the following case:

## CASE REPORT

A 63 year old, white male had intermittent claudication in the left leg and foot at rest. The femoral artery pulses were equal bilaterally but no pulsations were felt lower in the



FIG. 2. Arteriogram shows generalized arteriosclerosis with narrowing and irregularity of vessel lumen. No segmental blockage. This case is suited for sympathectomy.

left leg. Vasodilator drugs had given no relief. Arteriography (fig. 2) showed a generalized process without definite segmental occlusion and there was a good response to sympathetic block. After left lumbar sympathectomy, the patient's symptoms disappeared and he has returned to his electrician's job.

*Direct Approach on Occluded Vessel:* Vascular surgery has experienced revolutionary advancement during the last 4 years as a result of the successful operations on occluded vessels. Blood flow is restored by endarterectomy,<sup>11</sup> the excision of a thrombotic intima, or more commonly by the use of a vascular graft. These are of two types: (1) arterial homograft,<sup>2,9</sup> or (2) a prosthesis of synthetic cloth.<sup>1,3</sup> The following cases illustrate methods of directly dealing with a segmentally occluded artery:

#### CASE REPORTS

A 59 year old, white male presented himself for examination with the complaint of intermittent claudication in the right calf of 3 months duration, with an acute onset. Artery palpation revealed absence of pulsation on the right below the femoral. Arteriogram (fig. 3) showed superficial femoral artery segmental occlusion with adequate distal and proximal vessels. This patient's problem was managed by exclusion and bypassing of the occluded



FIG. 3. Femoral arteriogram showing segmental occlusion of the right superficial femoral artery and satisfactory proximal and distal segments. Ideal case for vessel graft.

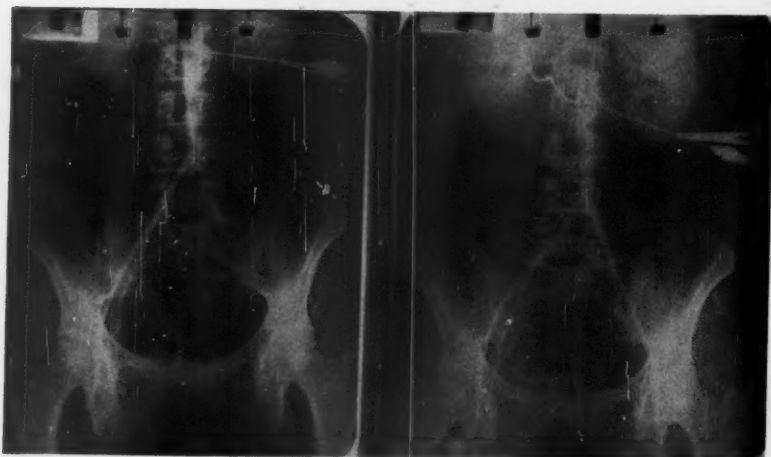


FIG. 4. Aortogram. A—Preoperative. Segmental occlusion of left iliac artery. B—Post-operative. Adequate restoration of vascular continuity.



segment, using a crimped nylon tube<sup>3</sup> with end to end proximal anastomosis and end to side distal anastomosis. The patient was discharged without symptoms and with adequate peripheral pulses.

A 52 year old, white female was admitted to the hospital because of hypertension, headache, and claudication of the left leg. Studies of the hypertension and headache revealed no serious organic processes. There was absence of pulsations in the left lower extremity. The right lower extremity was normal. An aortogram (fig. 4a) showed occlusion of the left common iliac artery. At exploration the arteriosclerotic blocked segment was removed and a nylon graft inserted. Postoperative, normal pulsations were present bilaterally and the aortogram (fig. 4b) showed adequate vessel restoration. The patient's symptoms have disappeared.

#### COMMENT

We have witnessed tremendous advances in vascular surgery in recent years. Lives and extremities are saved by a combination of earlier diagnosis and new methods of treatment. This has been partially brought about by the judicious use of arteriography and sympathetic block, which have pointed more clearly to a precise diagnosis.

It is mandatory to distinguish diffuse arteriosclerosis—with or without segmental occlusion—from "pure" segmental occlusion. While these are probably quantitative variations of the same disease process, management is different. A large group with diffuse arteriosclerosis are helped by sympathectomy and not by a vascular substitute. Actually, grafts in these cases usually fail. Another sizeable group, those with "pure" segmental occlusion, have benefited primarily from vessel grafting. Surgical publications focus the accelerated significant progress in the various types of grafts and in the many methods of using them. Arterial homografts and some synthetic cloth prostheses seem equally satisfactory. Synthetics, especially nylon and teflon<sup>4, 5</sup> are now popular. Various techniques of anastomoses; the pros and cons of anticoagulants, and other factors; have received extensive study. The ultimate success, however, depends on: (1) a volume of blood under adequate pressure, and (2) a satisfactory peripheral bed.

#### CONCLUSIONS

The armamentarium of the vascular surgeon is increasing at a rapid rate and many good methods of handling inadequate circulation are available. Therefore, the greatest emphasis should be placed on individualized treatment—or on the application of the correct surgical procedure at the right time, at the right place, and in the right patient.

301 N.W. 12th St.

Oklahoma City 3, Okla.

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## PATELLECTOMY: REPAIR BY QUADRICEPS TENOPLASTY

H. O. MARSH, M.D.\*, H. O. ANDERSON, M.D.\*, OCTAVIO PLIEGO, M.D.†

*Wichita, Kan.*

The value of the patella in effective knee mechanism has been so overemphasized that the patella has achieved an unwarranted status of inviolability. It is a useful part of the knee mechanism when normal, but a defective patella may interfere so severely with function that an otherwise competent joint may be reduced to ineffectiveness. Our experience with patellectomies, which I wish to report, has proved that a knee may function effectively without this bone. This summarization is an attempt to focus attention on this valuable technic and present our concept of the indications, operative technic, postoperative care, and the excellent results that may be obtained.

Mechanical disorders of the patello-femoral mechanism challenge the physician to choose between conservative surgical procedures preserving this articulation or its elimination by the more radical patellectomy. Conservative medical procedures cannot cure a mechanical derangement. The physician, therefore, is forced to a choice between medical procrastination while the "knee burns" or the selection of a definitive surgical procedure. This ever recurring dilemma presents one of the challenging enigmas of orthopedics. This statement is substantiated by the multiplicity of treatment methods, both conservative and surgical, the varied criteria for open or closed reduction of patellar fractures and dislocations, the confusion of indications and contraindications for patellar excision, and the doubt some authors have expressed of the value of the patella. A successful orthopedic technic must have a clearly defined field of usefulness, be capable of duplication by qualified surgeons, require a minimum of postoperative care, and produce excellent long term results.

The exact value and necessity of the patella to knee function is a controversial subject. Brooke<sup>1, 2, 3</sup> maintained that the patella was not essential to knee function and could be excised with impunity. Other authors<sup>4, 5, 6, 8</sup> have indicated that the patella contributes to the strength of the quadriceps mechanism by a pulley action and by a lever action produces the last few degrees of extension. Protection of the femoral condyles from the frequent minor trauma of daily existence, thus preventing traumatic osteoarthritis, has also been advanced as a function of this bone. This cannot be a major concern for the femoral condyles are protected from direct trauma by a soft tissue buffer comprised of skin, adipose tissue, and joint capsule, and in kneeling the body weight is borne on the tibial tubercles. The patella does have a cosmetic value and, in women, this factor must be equated.

It must be conceded that the multiplicity of patello-femoral problems makes

\* From the Orthopedic Department, Wichita Clinic, Wichita, Kansas.

† From the St. Francis Hospital, Wichita, Kansas.

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a universal solution impossible and illogical. Certain conditions or degrees of conditions have more effective remedies than patellectomy: (1) for transverse fractures without significant displacement or comminution, open or closed reduction may be advisable; (2) for fractures with one major fragment, partial patellectomy is effective; (3) for early cases of chondromalacia, partial excision of the articular cartilage or patellaplasty is indicated; (4) for recurrent dislocation prior to degenerative changes, transplantation of the patellar tendon medially on the tibia will produce excellent results.

Indications for patellectomy are: (1) comminuted fractures; (2) malunited fractures; (3) nonunion; (4) advanced osteoarthritis of the patello-femoral mechanism; and (5) chronic symptomatic chondromalacia; and (6) recurrent dislocation with degenerative changes.

The presentation and evaluation of a surgical procedure such as patellectomy must be undertaken with the intention of supplying additional helpful information. We have utilized for 15 years a technic of patellectomy with quadriceps tenoplasty which has solved certain of the inherent difficulties of this procedure. The critical advantages achieved are conducive to better results. These advantages are: (1) immediate antigravity strength of the suture line is attained by reinforcement with a strip of quadriceps tendon; (2) rehabilitation with quadriceps exercises and knee motion is instituted on the first postoperative day; (3) partial weight bearing is permissible; (4) postoperative immobilization is unnecessary thus circumventing one obstacle to a successful result. In our experience, immobilization has frequently been productive of decreased joint motion and increased disability; (5) the surgical technic is not difficult and postoperative care is simple.

#### TECHNIC

The standard anteromedial incision permits wide exposure of the extensor mechanism of the knee. The patella is excised by sharp dissection preserving all healthy soft tissue, and all debris is removed from within the joint. The surgical defect is repaired with the knee in extension plicating the capsule transversely under modest tension with mattress sutures. A triangular tongue of tendon from the superficial layer of the quadriceps tendon (that of the rectus femoris) is reflected distally. The apex of this tendon flap is 4 inches above the former patellar site, and the base is 2 inches in width. The reflected portion of the quadriceps tendon is split longitudinally into two equal segments in a sagittal plane. A small hemostat is forced transversely through the mid point of the patellar tendon creating a tunnel. The reflected tendon strips are drawn through this opening from the respective medial or lateral side and sutured under moderate tension. Superficial to the patellar tendon, the tails of the tendon flaps are again crossed and sutured. The edges of the tendon donor site are approximated with interrupted sutures. After wound closure, a pressure dressing is applied to minimize postoperative swelling; no further attempt is made to immobilize the knee.

Quadriceps muscle exercises and active knee motion are initiated the first postoperative day. The patient is encouraged to be as active as possible. Crutch

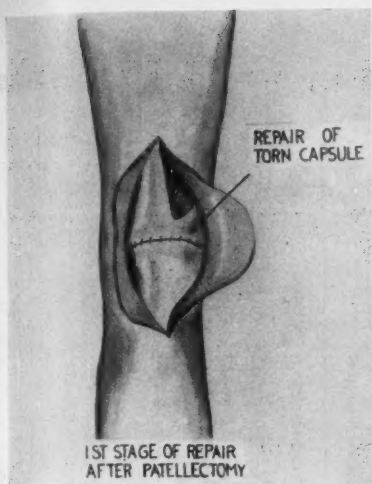


FIG. 1

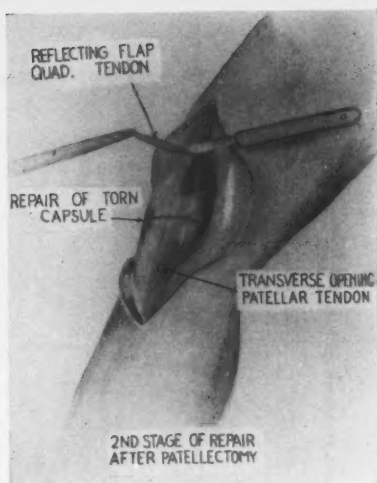


FIG. 2

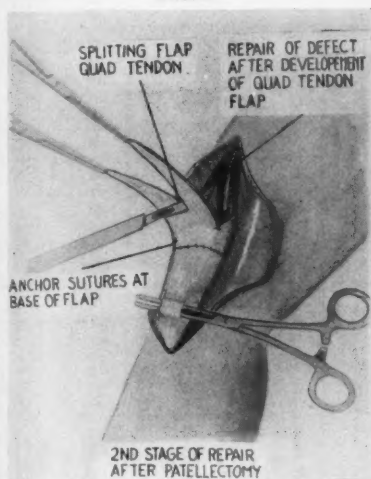


FIG. 3

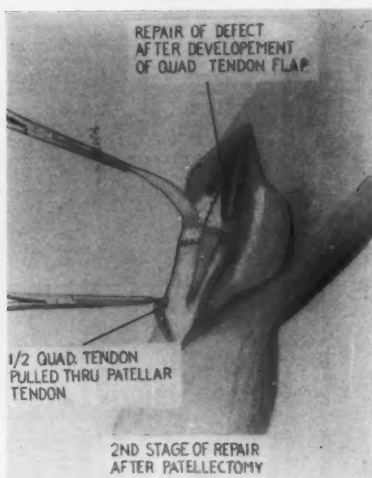


FIG. 4

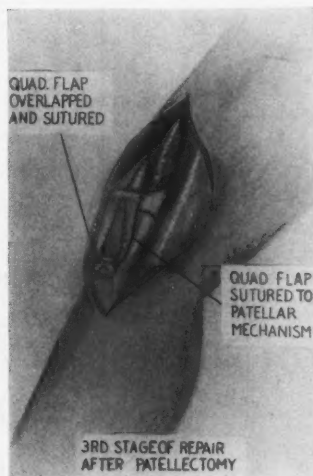


FIG. 5

TABLE 1  
Analysis of Results

Patient	Sex	Age	Post Op. Yrs.	Atrophy	Pain	Gait	Stair Walk	Range Motion	Power (Pounds)						Return to Prev Vocation	Patients Comments	Results				
									90°									135°		180°	
									OP	N	OP	N	OP	N				OP	N		

I. Fractures																		
(A) Simple Fractures																		
W. M. O.	M	45	1½	1"	Ache with sitting	Normal	Slight diff.	180-30	37	60	35	60	36	60	Yes—4 weeks	Farming	Reg. work but slower	Good
E. D.	M	1½	Yes	Ache with sitting			With slt. diff.	(Multiple severe injuries)										Family M.D. rates excell. (?)
B. H.	F	51	½	¾"		Normal	Slight diff.	180-60	9	25	0	24	9	21	Yes—4 weeks	Steno		Good
F. G. R.	M	40	½	¾"	Tender	Normal	Normal	180-60							Yes—Carpenter			Excellent
M. L. K.	F	48	1	½"	Tender	Poor	With diff.	175-80	12	35	7	45	5	16	No—7 months	Light work		(Compensation)
E. J. P.	F	47	1	½"	None	Normal	Normal	180-30	23	24	15	18	14	16	Yes—6 weeks	Housewife	Op. knee is good	Poor
																		Excellent

(B) Simple Comminuted Fractures																		
C. W. H.	M	43	3	¾"	Constant sit. ache	Normal	Diff. had fractured feet	175-50	31	45	22	45	20	32	Yes—8 weeks	Boeing	Satisfact.	Good
R. I. G.	M	43	3	Slight	None	Normal	Normal	180-40	(Would not permit test)						Yes—12 weeks	Salesman	Very well satisfied	Excellent
F. A. P.	M	61	8½	¾"	Slight soreness	Normal	Slight diff.	180-60							Yes—8 weeks	Warehouseman	Very satisfied	Good
F. B.	M	46	5	¾"	With twist motions	Normal	Slight diff.	180-30										(Compensation)
E. D.	M	1½	Yes	Yes	Ache with sitting			(See under simple fractures)										Good
M. R.	F	30	6	1¼"	None	Normal	Normal	180-30	32	60	25	60	25	60	Yes—8 weeks	Housewife	Very well pleased	Excellent (?)

(C) Compound Fractures																		
P. R.	F	30	1½	0"	None	Normal	Sl. diff. going down slight diff.	180-30	22	60	21	35	13	17	Yes—8 weeks	Factory worker	Very satisfied	Excellent
A. M. L.	M	43	1		Moderate with time										No—6 months	Lighter work	Satisfied (letter)	Good



II. Osteoarthritis

P. R.	F	30	1½	0"	None	Normal	Sl. diff. going down Slight diff.	180-30	22	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	90	94	98	100	Stiffness and ache (letter)	Very satisfied (letter)	Excellent	Good
A. M. L.	M	45	1		Moderate with use	Normal	Sl. diff. going down Slight diff.	180-30	22	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	90	94	98	100	Stiffness and ache (letter)	Very satisfied (letter)	Excellent	Good
O. R. E.	M	33	5	3½"	Mild after exercise	Normal	Not 10" stops	180-30	22	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	90	94	98	100	Stiffness and ache (letter)	Very satisfied (letter)	Excellent	Good
M. P.	F	50	4½	Yes	None	Slight limp	With diff.	170-125	22	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	90	94	98	100	Stiffness and ache (letter)	Very satisfied (letter)	Excellent	Good
M. S.	F	55	4½	3½"	Constant ache	Good	With diff.	180-55	22	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	90	94	98	100	Stiffness and ache (letter)	Very satisfied (letter)	Excellent	Good
B. M.	M	55	4	Yes	Mild ache	Normal	With diff.	180-40	22	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	90	94	98	100	Stiffness and ache (letter)	Very satisfied (letter)	Excellent	Good
O. R. W.	F	73	2½	Slight	Both knees pain	Good	Diff. going down	180-85	22	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	90	94	98	100	Stiffness and ache (letter)	Very satisfied (letter)	Excellent	Good
C. E. E.	M	41	15		Slight	Good	Diff.	180-55	22	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	90	94	98	100	Stiffness and ache (letter)	Very satisfied (letter)	Excellent	Good
F. A. B.	M	50	6	Yes	Constant	Good	Diff.	175-60	22	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	90	94	98	100	Stiffness and ache (letter)	Very satisfied (letter)	Excellent	Good
C. S. F.	M	54	8		None	Good	Min. diff.	180-45	22	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	90	94	98	100	Stiffness and ache (letter)	Very satisfied (letter)	Excellent	Good
R. H. F.	M	58	8	¾"		Good	Min. diff.	180-40	22	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	90	94	98	100	Stiffness and ache (letter)	Very satisfied (letter)	Excellent	Good

III. Chondromalacia

P. R.	F	50	4	Some	None	Normal	Some diff.	180-30	22	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	90	94	98	100	Stiffness and ache (letter)	Very satisfied (letter)	Excellent	Good
O. E. T.	F	50	4	Some	None	Normal	Some diff.	180-30	22	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	90	94	98	100	Stiffness and ache (letter)	Very satisfied (letter)	Excellent	Good
A. H.	F	26	2½	1½"	None	Normal	Some diff.	180-30	22	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	90	94	98	100	Stiffness and ache (letter)	Very satisfied (letter)	Excellent	Good
R. G.	F	49	3	1" Larger	Ache with sitting	Normal	Some diff.	180-55	22	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	90	94	98	100	Stiffness and ache (letter)	Very satisfied (letter)	Excellent	Good
M. J.	F	43	2		Ache with sit or stand	Normal	Slower	180-50	22	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	90	94	98	100	Stiffness and ache (letter)	Very satisfied (letter)	Excellent	Good
			3		Ache with sit or stand			180-50	22	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	90	94	98	100	Stiffness and ache (letter)	Very satisfied (letter)	Excellent	Good

IV. Non-union or mal-union

		M	40	1	3½"	Tender	Normal	Normal	180-30	55	40	Yes—4 weeks	Carpenter	Very well satisfied	Excellent				
F. G. R.	M	40	1	3½"	Tender	Normal	Normal	Normal	180-30	55	40	Yes—4 weeks	Carpenter	Very well satisfied	Excellent				
K. L. K.	F	17	1½	1¼"	Occ. ache	Normal	Normal	Normal	180-30	23	24	15	18	14	10	Yes—4 week	Student	Very act.	Excellent

V. Chronic Recurrent Dislocation

B. E. H.	M	22	8	1½"	Dull ache	Normal	Some diff.	180-50	12	50	14	60	13	60	Yes—5 months Bull- dozer	"Worthwhile"	Fair
V. E.	F	50	13	1½"	None	Normal	Normal	180-50	9	17	14	19	10	12	Yes—2 weeks Tele. op.	Good	Excellent
R. B. P.	M	54	2	¾"	Constant ache	Normal	Min. diff.	170-50	24	60	30	60	24	60	Yes—12 weeks Mechanic	Good	Good
S. V.	F	47	2½	1"	None	Normal	Min. diff.	180-30	16	33	9	30	5	25			Good
V. H.	F	33	1½		Constant ache	Poor	Great diff.	150-90	6	3	3	0	0		Not returned to work	Poor	Poor
								130-90	8	2	2	0	0			Poor	Poor

walking is started on the fourth or fifth day and continued for 2 or 3 weeks after which the patient is ambulatory without support.

#### RESULTS

In the past 15 years we have had 31 patients requiring patellectomy, 15 males and 16 females. Five bilateral patellectomies were performed, making a total of 36 operations. Twenty-seven knees were personally re-examined and evaluated, 5 knees were evaluated by form letters, and 4 were lost to follow-up. The median age was 46 years; the youngest patient was 17 and the oldest 73. The median age postoperative follow-up period was  $2\frac{1}{2}$  years, this varied from 3 months to 15 years. There were 14 cases of acute patellar fractures, 9 cases of osteoarthritis, 5 patients with severe chondromalacia, 2 with nonunion or malunion, and 6 with recurrent dislocation of the patella with degenerative joint disease.

Quadriceps strength was tested by a spring scale in 3 knee positions, 180°, 135°, and 90°. The power in the patellectomized knee was always less than the unoperated knee in all 3 test positions and was most marked in full extension. We believe that this decrease in strength was secondary to the loss of the patellar pulley action. Quadriceps atrophy was demonstrable in all cases and varied from  $\frac{1}{2}$  inch to a 2 inch decrease in thigh circumference. Diminution of quadriceps power and some atrophy was undoubtedly present in a number of patients preoperatively. The rapidity with which quadriceps power and good knee function was regained was directly proportional to the patient's diligence in applying himself to his rehabilitation program. There was a complete range of active knee motion in 11 patients, while in the remaining 25 there was some loss. Limitation of knee motion had been anticipated preoperatively in many of these patients. Degenerative conditions of the knee usually produce limitation of motion, and a patellectomy cannot overcome this handicap. The average patient returned to his vocation in 8 weeks.

#### EVALUATION OF RESULTS

Conditions which already had caused irreversible joint changes were frequently the indications for patellectomy in this series of cases. Prior to surgery atrophy, limitation of motion, loss of quadriceps strength and gross discomfort frequently were well established. Careful evaluation of these factors convinced us that an excellent result is frequently not a normal knee but may well be a knee in which a serviceable range of motion has been obtained but not restored to normal, pain markedly decreased but not eliminated, and the patient's physical capacity increased to a useful functional degree.

Knowledge that a patellectomy will not restore a knee to normalcy in certain disabling conditions should not deter us from its employment given the proper indications. A knee incapacitated 50 per cent by osteoarthritis, chondromalacia, or traumatic incongruities of joint surface and restored to a 15 per cent disability is a highly successful result. The surgeon must evaluate this procedure, as in other reconstructive operations, on a percentage of improvement factor. There must be a wide enough operating margin between the preoperative percentage

of disability and the estimated postoperative percentage of disability so that the patient and the surgeon will both be satisfied with the gain obtained. There can be no successful result without thoughtful consideration of this improvement factor.

Equation of all factors, subjective and objective, plus a clear concept of the patient's preoperative condition, was essential for classification of results in four groups. There were 11 excellent results, 15 good results, 7 fair and there were 3 poor results (table 1). Patellectomy produced the poorest results when performed for old recurrent dislocations with degenerative changes. The best results were obtained when patellectomy was performed for acute fractures.

*Orthopedic Dept.*

*Wichita Clinic*

*Wichita, Kan.*

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## COLLOID CARCINOMA OF THE COLON IN CHILDREN

J. A. BUCHMAN, M.D., J. D. CALHOUN, M.D.

*Little Rock, Ark.*

Carcinoma of the colon in children below the age of 16 is not as rare as previously thought. A review of the literature does not reveal many reported cases. However, an interesting bit of information is that cures are very uncommon. Thus it would seem since there are no reported cures that few of the cases are reported. It is the purpose here to emphasize that carcinoma of the colon in children is more frequent than generally realized, and good results can be looked for when the diagnosis is made early and treatment promptly instigated. A high per cent of these carcinomas are of the colloid type.

Carcinoma of the colon in children as in adults is less frequent than is carcinoma of the rectum and rectosigmoid. One cannot exclude carcinoma of the colon from the diseases of children and adolescents on the basis of age alone.

We have been able to collect 50 cases of proved carcinoma of the large bowel excluding rectum and rectosigmoid in patients 16 years of age and under. As mentioned before, most of these patients terminated unsatisfactorily, so it is our impression that this does not represent a true incidence of carcinoma of the colon in the age group studied.

### CASE REPORTS

Case 1. D. M.: (photomicrograph No. 1): This patient was a 15 year old white male who presented himself complaining of occasional crampy abdominal pain for the past 8 weeks. He had had a palpable, slightly tender mass in the left lower quadrant for the past 3 weeks. This mass was firm, nontender, measured 4 by 6 cm., and was slowly increasing in size.

The hemoglobin was 12.5 grams with a 6,500 white count. The white cell distribution was normal.

Physical examination was normal except for the palpable left lower quadrant mass. The rectal examination and the sigmoidoscopic examination were normal.

The roentgenologist reported a complete obstruction of the colon in the upper sigmoid area which corresponded to the palpable mass in the left lower quadrant. There was no evidence of dilatation of the colon or small bowel proximal to the point of obstruction. It was the opinion of the roentgenologist that the obstruction was secondary to an old pericolic abscess rather than to a malignancy.

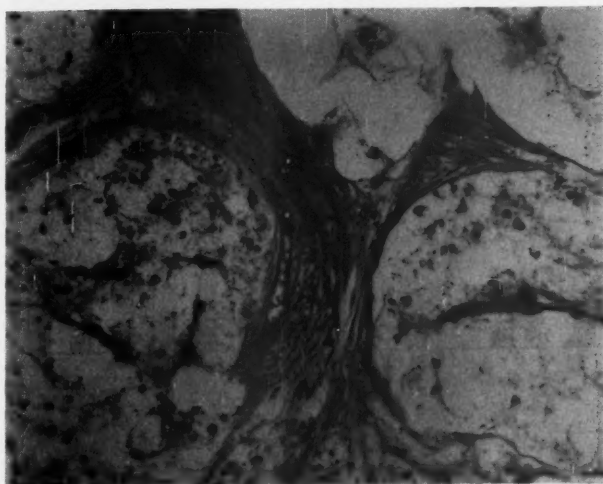
At surgery the boy was found to have a large mucoid type of carcinoma of the upper sigmoid colon with a small liver metastasis. A radical left colon resection was done, and 10 days later a partial right lobe resection of the liver was one.

The patient survived approximately 6 months and died of diffuse carcinomatosis.

Case 2. M. M.: (photomicrograph No. 2): This 13 year old white female presented herself complaining of vague epigastric and para-umbilical pain for 3 months and a weight loss of 6 pounds. Pains had been very severe for 10 days, and she had nausea and vomiting for 8 days.

Her last normal menstrual period was 10 days prior to the examination. Laboratory findings showed a hemoglobin of 12 grams, a white count of 7,600 with a normal distribution, and a normal urinalysis.

Presented during the Wichita Assembly of The Southwestern Surgical Congress, April 15-17, 1957, Wichita, Kansas.



Slide 1



Slide 2

Physical examination revealed a slightly obese white female who did not appear to be acutely ill. The abdomen was flat. There was an 8 by 10 cm. firm tender mass just to the right and below the umbilicus. This mass was fixed. Rectal examination was normal.

Examination of the heart and lungs was essentially normal.

The abdomen was opened through a McBurney incision on the day of admission. The incision was extended and the diagnosis of carcinoma of the colon was established, so the bowel was decompressed. Ten days later a radical resection was done for a mucoid carcinoma of the splenic flexure.

The patient was followed carefully, and 26 months later by rectal examination she was found to have a cul de sac mass which was freely movable.

### Age Incidence

carcinoma of colon in children-16 and under  
50 cases

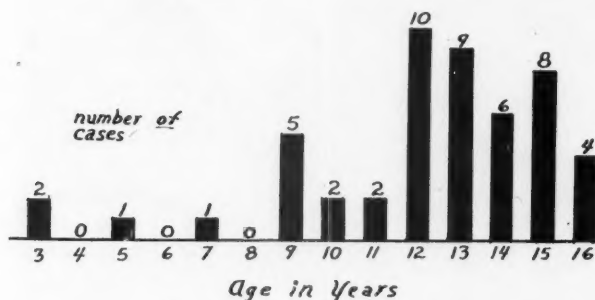


FIG. 1. Age incidence in collected cases

She was readmitted to the hospital and explored, and a large Krukenberg tumor of the left ovary was removed. At this time she had gross metastasis to other abdominal organs. She died approximately 4 months later of generalized carcinomatosis.

### Age and Sex (Fig. 1 and 2)

There has been the case of 1 patient reported at the age of 3 years. The greatest incidence of the disease occurred at 12 years of age. There is a marked predominance for the male sex to be afflicted. This, of course, agrees with the sex incidence of carcinoma of the colon in adults since most authors agree that many more males are affected than women.

### Site of Growth (Fig. 3)

The distribution of the primary site of growth in the age group studied was essentially the same as the distribution in adults. There is no explanation known

### Sex Incidence

carcinoma of colon in  
children-16 and under

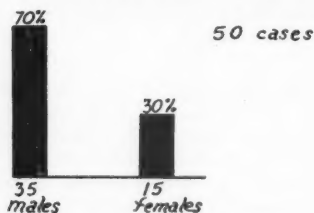


FIG. 2. Sex incidence in reviewed cases of carcinoma of colon in childhood and adolescence



*Location of Lesion  
carcinoma of colon in  
children - 16 and under*

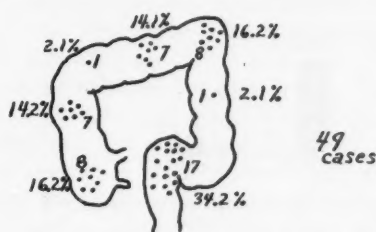


FIG. 3. Variation of site of lesion in collected cases

for the increased frequency of carcinoma in the pelvic colon which one finds both in children and in adults. In adults the frequency of acute complete obstruction associated with carcinoma of the colon varies from 16 to 35 per cent. One cannot determine from the literature the exact frequency of acute obstruction in children, but it is thought to be much higher, possibly in the neighborhood of 70 per cent. The patients in the 2 cases herein reported were first seen because of complete obstruction. Many times in the literature comment was made on the marked distension and hypertrophy of the small bowel which would suggest that there had been some degree of obstruction.

#### *Prognosis*

Malignant diseases in general in the young are much more virulent than in the adult. This is also true of carcinoma of the colon and is well borne out by the results quoted in the literature. However, one is impressed when reviewing the literature that the most important single factor in this poor prognosis is the failure to accurately diagnose the disease so that an early and accurate regime of therapy can be carried out. Occasionally death was due to poor surgical judgement such as resecting local lesions in the face of acute obstruction. Four years was the longest survival recorded.

#### *Pathology*

In 43 cases an accurate microscopic diagnosis was given. In 20 (or 46 per cent) the diagnosis was colloid or gelatinous carcinoma. This would indicate that the incidence of colloid carcinoma of the colon is much higher in children than in adults (fig. 4). In adults it has been reported by various authors to be in the neighborhood of 4.9 to 5 per cent. Colloid carcinoma tends to grow slower and metastasize later than the adenocarcinoma without colloid. Broders defines colloid carcinoma as an adenocarcinoma with a tendency to differentiate to the extent that a mucus-like secretion is formed. Ewing describes colloid carcinoma as spreading over a considerable length of intestine producing bulky tumor

### *Incidence of Colloid Carcinoma*

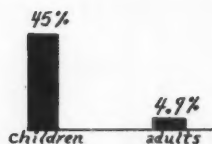


FIG. 4. Marked difference in relative frequency of colloid carcinoma in children and adults.

masses which extensively replace the original tissue growth. Growth of mucoid carcinoma is chiefly by expansion and permeation, thereby making transplants common. In general, colloid carcinoma has a higher eventual mortality but usually shows greater longevity with later metastasis. Occasionally pseudomyxoma peritoneae or accumulation of gelatinous bodies resembling tapioca within the peritoneum may be associated with colloid carcinoma of the colon. Unfortunately, in most of the reported cases there is no mention of the presence or absence of associated polyposis.

#### *Diagnosis*

The only difference between the colon malignancies occurring in children and those in adults seems to be in the shorter duration of symptoms which probably is due to the more rapid growth of tumors in the younger age group. It must be mentioned that the majority of the patients in the cases in the series herein reported were first actively treated after intestinal obstruction had supervened. That is certainly true in the 2 cases we are adding to the literature. This would seem to indicate the obscure early symptomatology of neoplasms of the large bowel in children, and it would also seem to reflect the tendency of many practitioners to completely exclude the possibility of cancer of the colon from this age group on the basis of their age alone.

It is well to remember that the right colon which extends from the cecum to the midtransverse area is primarily absorptive in function and thereby functions more like the small gut, whereas the left colon extending from the midportion of the transverse colon to the rectum is primarily a storehouse. This basic difference influences the symptomatology so that two different clinical types frequently occur. Carcinomas of the left colon generally present a typical clinical picture dominated by obstructive phenomena, that is, changing bowel habits such as increasing constipation or diarrhea due to inflammatory irritation, and the presence of dark to bright red blood in the stool. Obstructive symptomatology is not

frequent on the right side except when the neoplasm encroaches upon the ileocecal valve.

The right colon lesions usually manifest themselves by anemia, weight loss, and vague abdominal complaints associated with weakness and easy fatigability. Many times lesions of the right colon will not be recognized until there is a palpable right-sided abdominal mass.

Malignant lesions of the colon, either right or left, may present symptoms which are so vague as to make diagnosis almost impossible on the basis of symptomatology alone. Persistent abdominal discomfort (especially if it occurs several hours after the ingestion of food), flatulence, and easy fatigability demand careful investigation of the entire colon. This is best done by sigmoidoscopic examination and by a barium enema. The use of one without the other is not sufficient.

In the differential diagnosis one must consider such things as (1) granulomatous lesions of the large bowel such as tuberculosis, regional ileitis, amebiasis; (2) ruptured appendix with localized peritonitis; (3) intussusception, possibly due to a polyp, a diverticulum, or a tumor; (4) nonspecific chronic pyrogenic lesions; (5) foreign bodies; (6) congenital megacolon; (7) tumors outside the gastrointestinal tract such as Wilms' tumor.

#### *Treatment*

The treatment of carcinoma of the colon in children is the same as in adults. It is safe to assume that good results can be obtained with early diagnosis and radical surgical removal. The operative procedure should be more radical in children than in adults for it is the only chance of cure.

Extensive abdominal surgery is withstood well by children if one watches carefully the blood loss and one prepares the bowel prior to surgery. Since so many of these patients first present themselves with bowel obstruction, intestinal decompression may be a necessity.

#### *SUMMARY*

Fifty authentic cases of carcinoma of the large bowel have been reviewed.

Colloid or gelatinous carcinoma is more frequent in children than in adults, and it is thought that this explains the common finding of a palpable abdominal mass.

The signs and symptoms of carcinoma of the colon in children are the same as in adults.

It is unfortunate but true that most of the patients in the cases reported have been treated for many months before the exact diagnosis was established.

The prognosis today is dismal, and it is hoped that with increased education this prognosis can be improved.

1218 W. 6th St.  
Little Rock, Ark.

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## CONGENITAL ABSENCE OR HYPOPLASIA OF A PULMONARY ARTERY

CLARENCE A. BISHOP, M.D., EUGENE T. HANSBROUGH, M.D.

*Little Rock, Ark.*

Congenital absence or hypoplasia of a pulmonary artery in the past has been considered to be a rare occurrence. Through 1952 only 11 such anomalies could be found in the literature. There now have been at least 28 reported cases and it is assumed that there will be many more cases reported as this condition becomes more commonly recognized.

A short resume of the embryology of the lung and its vasculature may better the understanding of how such anomalies occur. The lung epithelium may be recognized as a ventral thickening of the foregut (pharynx) as early as the twenty-fifth-twenty-seventh day in the embryo. Soon afterwards, the bronchial buds begin to grow out as the short primary bronchi. During the fifth week, the right primary bronchus gives rise to two lateral buds whereas the left gives rise to only one. These branch and rebranch so that at 2 months of embryonic life there are the characteristic three lobes on the right and two lobes on the left. At 6 months of prenatal life there have been 17 orders of branching and rebranching. After birth there is additional branching to 24 orders. This is important in lung surgery of children (2-3 years of age) in whom true hyperplasia of the remaining lung may be obtained, whereas, and in contradistinction to, adults can be expected to have only overdistention and emphysema in similar circumstances.

The pulmonary vasculature is derived from both a ventral and a dorsal anlage joined together by the postbranchial plexus. The dorsal anlage arises from aortic branches which normally disappear as the ventral segment develops into the main pulmonary artery. When the ventral connection to the pulmonary plexus fails to develop normally, the dorsal aortic branches may persist. Thus the lung may develop aortic, bronchial or systemic arterial supply to compensate for a deficient or absent pulmonary system.

Congenital absence or hypoplasia of a pulmonary artery to a lung is necessarily often associated with compensatory enlargement of the bronchial or systemic systems to that lung. In such cases there may or may not be gross anomalous development of the pulmonary tissue or bronchial tree. Congenital anomalies of the pulmonary artery may also occur with or without associated heart disease.

In the cases to be presented, one patient had hypoplasia of the left pulmonary artery associated with failure of the bronchial tree of the left lung to rebranch more than the 17 orders as seen in an infantile lung. There was also a severe, diffuse, congenital bronchiectasis necessitating pneumonectomy. The other pa-

From the Surgical Service of the Veterans Administration Hospital, Little Rock, Arkansas.

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tient has refused exploration at present. It is believed, however, that he has no anomalous development of the bronchial tree.

When compensatory enlargement of the bronchial or systemic arterial systems to the lung occurs, it must be borne in mind that the affected lung receives only oxygenated blood (in absence of the pulmonary artery) therefore, the oxygen uptake in that lung obviously can only be fractional even in a perfectly aerated lung. The enlargement of the anomalous blood supply to the lung results in alterations of blood flow and pressure which may produce symptoms as hemoptysis, pulmonary congestion, or heart failure requiring surgical intervention.

#### CASE REPORTS

Case 1. C. P., a 24 year old, tall, thin white male, entered the hospital in September 1956 complaining of cough, expectoration and hemoptysis. These symptoms, although present for years, had been mild until 4 months prior to admission. Expectoration then increased to a constant one cup of yellowish sputum daily and there was chest pain on deep inspiration. He had never had dyspnea and had been able to do military duty without difficulty although hospitalized once in 1949 for hemoptysis while still in Service. Since discharge from the Army, he has had pneumonia twice within a 2 year period and one small episode of hemoptysis in addition to his present complaint.

Physical examination was essentially normal except for a moderate decrease in breath sounds over the lower left lung fields. Roentgenograms of the chest (fig. 1) revealed typical changes suggestive of an absent left pulmonary artery (see discussion). Bronchoscopy and bronchograms (figs. 2 and 3) revealed a marked, diffuse, congenital bronchiectasis as well as a reduction in the actual number of bronchioles on the left. Electrocardiograms were normal. On angiocardiogram (fig. 4) the left pulmonary artery failed to visualize. There

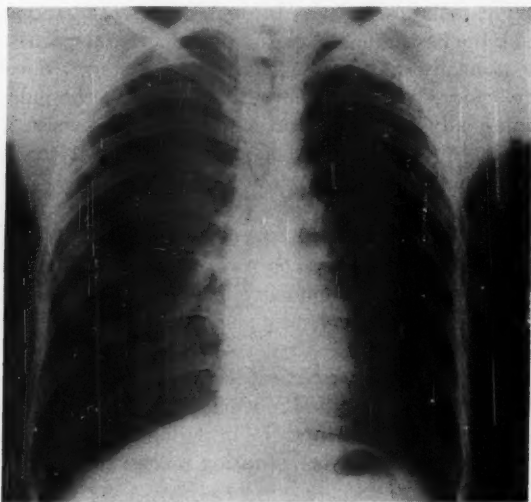


Fig. 1. Posteroanterior view of chest demonstrating: (1) Absence of left hilar vascular markings. (2) Left lung smaller than right lung with increase in radiolucency. (3) Overdistention of right lung. (4) Slight shifting of mediastinum to left.



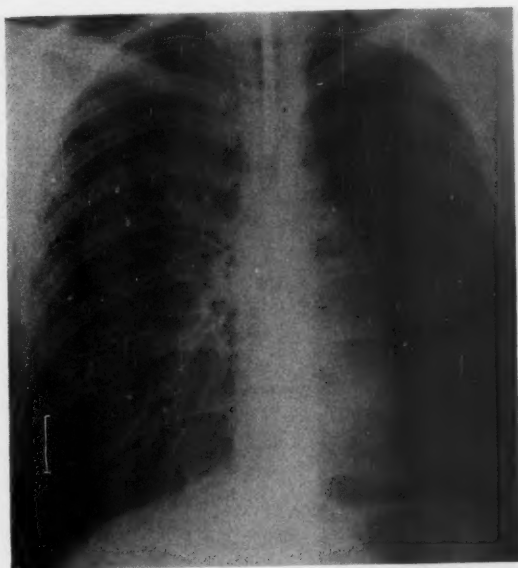


FIG. 2. One sided bronchogram reveals a normal bronchial tree on the right

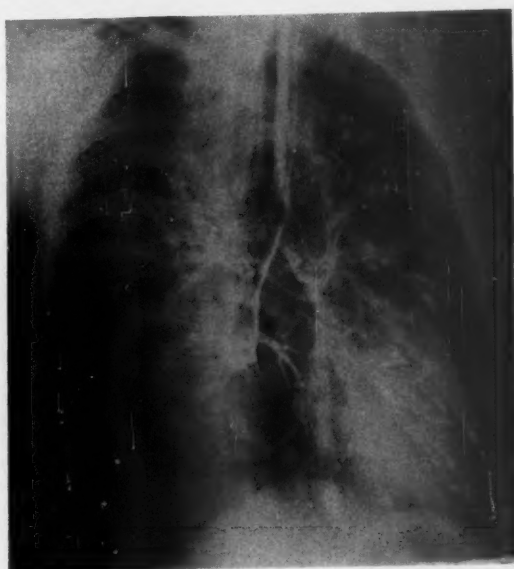


FIG. 3. Bronchogram demonstrating marked bronchiectasis and reduction in orders of rebranching.



FIG. 4. Angiocardiogram showing failure of left pulmonary artery to visualize. No evidence of any systemic anomalous arteries on films at later intervals.

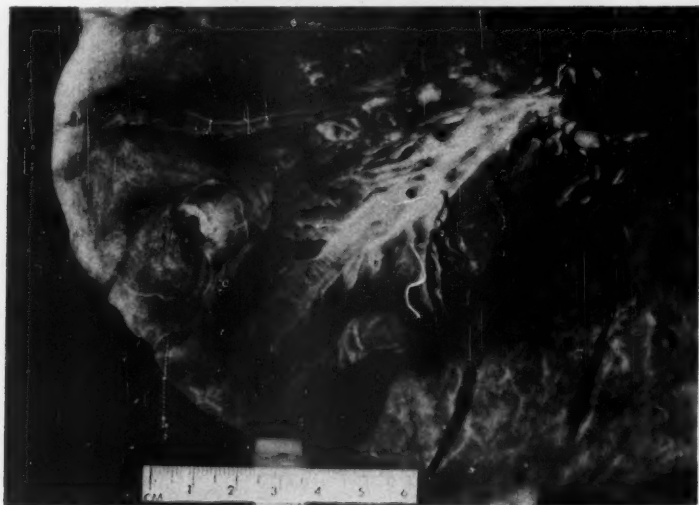


FIG. 5. Dissected bronchi showing lack of sufficient branching



FIG. 6. Microscopic section of lung demonstrating islands of undeveloped lung tissue

was no evidence of any large anomalous systemic artery to the lung. Bronchspirometric examination determined a marked reduction in oxygen uptake of the left lung. Lung volume, maximum breathing capacity and ventilation were within normal limits. Arterial oxygen saturation was 95.77 per cent. Because of the severe bronchiectasis present, pneumonectomy was performed in November 1956. At surgery the lung was light pink in color and infantile in general appearance. A very small hypoplastic left pulmonary artery was found just distal to the ligamentum arteriosum. This artery, only 4 mm. in diameter at its widest proximal base, supplied only the apical portion of the apical-posterior segment of the upper lobe and rapidly tapered down so that it was soon lost within the lung parenchyma. Only a minimal amount of blood could flow thru this artery accounting for its nonvisualization on the angiogram. A slightly larger pulmonary vein was present corresponding to the superior



FIG. 7. Microscopic section of lung demonstrating islands of undeveloped lung tissue

pulmonary vein with an apparently normal distribution of tributaries. A very large bronchial artery soon divided into two main branches just distal to the upper lobe bronchus, one of which supplied the upper lobe, the other supplied the lingula and the lower lobe. No other systemic vasculature was found.

There was a well defined but undeveloped interlobar fissure on section of the specimen. We believe there was no rebranching of the bronchi further than the seventeenth order with some failure of alveoli formation. Microscopic section showed numerous areas of undeveloped lung tissue (figs. 5-7).

Case 2. L. W., a tall and thin 32 year old white male, entered the hospital in December 1955 complaining of hemoptysis of 24 hours duration with the loss of approximately 500 cc. blood. He had three similar episodes in the past 7 years. He had a chronic cough with mini-



FIG. 8. Posteroanterior view of patient 2 showing marked similarity of cases. There is diminution of the hilar vascular markings on the left.



FIG. 9. Angiocardiogram demonstrating hypoplastic left pulmonary artery

mal expectoration in the past 5 years as well as mild dyspnea on exertion. Roentgenograms of the chest revealed a diminution of the hilar vascular markings on the left (fig. 8). There was minimal tubular bronchiectasis of the lower lobe on bronchography. Angiocardiograms (fig. 9) showed a small hypoplastic left pulmonary artery supplying only the left upper lobe segments with no branches to the lingula. This patient had only preliminary pulmonary function studies which were within normal limits except for reduced oxygen uptake on the left similar to the first patient. He refused studies and exploration at this time, but it is anticipated that he will consent in the future for he has already returned once because of hemoptysis.

This patient presents a different problem even though we believe him to have hypoplasia of the left pulmonary artery. Cardiac catheterization would be helpful in determining if there was a large left to right shunt. Bronchoscopy while bleeding might be done to be assured the bleeding is coming from the left lung. On exploration one might find an atresia present with a normal distal distribution or perhaps a large systemic vessel which would require definitive surgery.

#### DISCUSSION

Absence or hypoplasia of a pulmonary artery may be suspected (diagnosed) on routine chest roentgenograms. As outlined by Maier, there are well standardized changes to be seen. These changes are:

1. Absence or marked diminution of the normal hilar vascular markings on the affected side.
2. The affected lung may appear smaller than the normal in varying proportions although the entire lung may be well aerated.
3. Shifting of the mediastinum to the abnormal side with overdistention of the normal lung.
4. The diaphragm on the abnormal side may sometimes be elevated.

Angiocardiograms will usually clinch the diagnosis.

We believe very strongly, as does Gaensler and others, that pulmonary resection or pneumonectomy without important indications is contraindicated in spite of the fact that a great deal of dead space would be eliminated. We are becoming more and more concerned with the problem of overdistention and shift of the mediastinum after pneumonectomy. Preservation of the lung is of prime importance because the lung is its own best prosthesis to prevent hyperinflation of the opposite lung. We wish to emphasize that pneumonectomy was performed on the patient in Case 1 because of the high degree of bronchiectasis present and not because of the anomalous blood supply. Reiterating, bronchiectasis, repeated or chronic infection is one indication for pulmonary resection.

Our other indications for surgery are:

1. Evidence of cardiac failure because of a large shunting vessel from the systemic system to the lung.
2. Hypertension in the pulmonary system because of an anomalous systemic supply resulting in hemorrhage.

We believe this to be the indication for exploration in the patient in Case 2. Simple ligation of an anomalous systemic artery to the lung may effect a cure. The possibility of an anastomosis between a large systemic vessel and the pulmonary artery should be considered as should the feasibility of a graft of an atretic segment with a normal distal distribution.



## SUMMARY

Two cases of hypoplasia of the left pulmonary artery have been presented. Diagnosis, indications for surgery, and treatment have been discussed.

*Surgical Service**V. A. Hospital**Little Rock, Ark.*

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## TECHNIC OF CHOLECYSTECTOMY AND COMMON DUCT EXPLORATION

HENRY S. COLLIER, M.D.

*Instructor of Surgery, University of Louisville School of Medicine*

Cholecystectomy is the second most frequent abdominal operation, and the most frequent in the upper abdomen. Surgeons should be so familiar with the anatomic relations and anomalies in this region that operative damage should almost never occur. However, serious operative damage is not infrequent, although this could be prevented if the surgeon would always obtain and maintain adequate exposure. The following technic is designed to minimize errors of inadequate exposure.

A combination of many factors is required to obtain adequate exposure. Of these, the placing of the incision is of major importance. This incision is placed obliquely over the right upper quadrant and is basically the abdominal portion of the thoraco-abdominal incision. It has been described previously by others. In general, it parallels the course of the nerves, blood vessels, and fibers of the fascial planes of the upper abdominal wall. Beginning over the lower costal margin on the right in the seventh or eighth interspace, it extends obliquely and inferiorly across the right upper quadrant, crossing the midline approximately 2 inches above the umbilicus and ends about 2 inches to the left of the midline (Fig. 1). The deep fascia and muscles are incised the length of the skin incision. The external oblique fibers anterior to the costal margin and the anterior rectus sheaths are incised to the middle of the left rectus muscle. The right rectus muscle is divided. The left rectus muscle is retracted and the posterior sheath and peritoneum are opened from left to right up to the costal margin. Further length is obtained by extending the incision deep to the right costal margin, dividing the internal oblique and transversus muscles, the transversalis fascia and peritoneum for about 1.5 inches deep to the costal margin. For maximum exposure, the incision is extended to the left and the left rectus muscle may be divided. After placing a self-retaining retractor, a diamond shaped opening is obtained, with the widest point of the opening immediately below the costal margin, which is the infrahepatic region and adequately exposes the gallbladder and common duct region. The abdomen is thoroughly explored and the gallbladder should be palpated gently. If the gallbladder is tense or edematous, it is advisable to empty it with a trochar connected to suction. The fundus and the infundibular portions of the gallbladder are grasped with curved clamps for upward traction.

The first assistant now places his left hand deep into the infrahepatic region and retracts inferiorly. His hand is placed in such a manner that the thumb and index finger are to the right and the remaining fingers are to the left of the free edge of the hepato-duodenal ligament, as viewed through the incision (Fig. 2). It

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FIG. 1. Incision for cholecystectomy and common duct exploration. Costal cage with intercostal nerves are illustrated to show relationships to the incision.\*

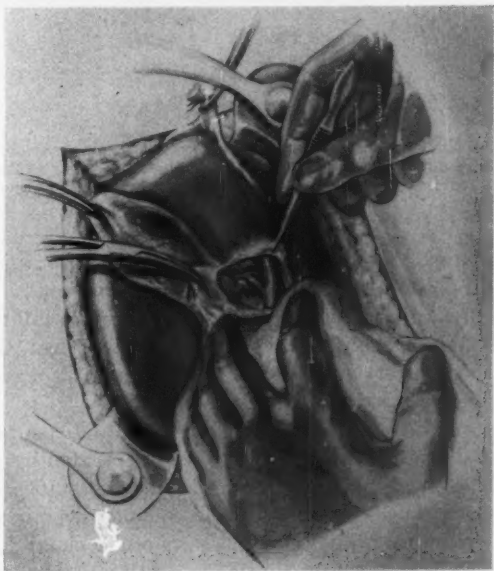


FIG. 2. Exposure of the subhepatic region. The peritoneal covering has been incised and displaced to visualize the cystic and common ducts and cystic artery. Notice the position of the assistant's left hand with index and middle fingers straddling the structures in the duodeno-hepatic ligament.

\* All illustrations by Mrs. Catherine Dauscher, Department of Visual Education, University of Louisville School of Medicine.

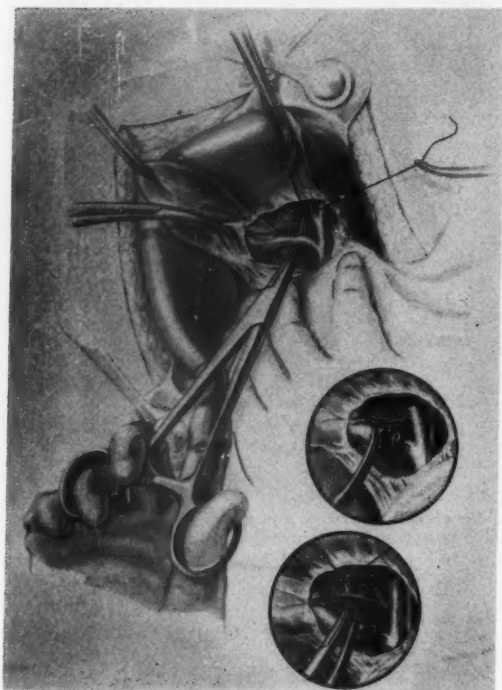


FIG. 3. Method of ligation of cystic duct and artery without placement of clamp in the danger zone. Large illustration shows placement of ligature under cystic duct. Upper insert shows cystic duct divided after ligation. Lower insert shows placement of tie under cystic artery.

is very important that this be done properly and that the assistant's hand be maintained in this position to give good exposure throughout.

The peritoneal reflexions and areolar covering over the infundibular portion of the gallbladder, the cystic duct, the common hepatic duct, the common bile duct, and the cystic artery are carefully incised and displaced for adequate visualization of these underlying structures.

After satisfactorily demonstrating the cystic duct and common hepatic duct and common bile duct junctions, the cystic duct is isolated by passing a closed right angle gallbladder clamp from below and underneath the cystic duct into the triangular space above, bounded by the common hepatic duct, the cystic artery, and the cystic duct. The tip of the jaws of the clamp face the surgeon. The jaws of the clamp are gently spread, separating the structures above the cystic duct, and a silk ligature is fed into the clamp (Fig. 3). When the right angle clamp is withdrawn from this position, it places the ligature under the cystic duct. The cystic duct is then ligated in continuity about .5 cm. from the junction with the common duct. The duct is clamped above the ligature and divided. The



FIG. 4. Method of treatment of gallbladder bed in liver for hemostasis. The electro-surgical tip is placed against the metal suction tube which becomes the coagulating source. The area is drained if the gallbladder is acutely inflamed or if there is excessive bleeding from the liver bed.

lower portion of the gallbladder is then retracted upward, thus straightening the cystic artery under slight tension, and a similar maneuver is used to isolate and ligate the cystic artery. It is easier to ligate and divide the cystic duct first because this improves the visualization of the artery.

The advantages of ligation of the cystic duct and artery separately and before dividing are:

1. No clamps are applied near the common bile duct.
2. There is less danger of hemorrhage or bile spillage from breaking or pulling off of a ligature as in tying around a clamp.
3. A cluster of clamps is never a problem.

The gallbladder is now removed from below upward by sharp dissection. Any bleeding that results from the liver surface is treated by coagulation, using contact of the electro-surgical point to an abdominal suction tip (Fig. 4). The metal suction tip is the coagulating source, as well as the means, by sucking out the blood and smoke, of accurately locating the exact bleeding points. No attempt is made to approximate the edges of the peritoneal reflexions over the liver bed. Placement of Penrose drains in the subhepatic space is determined by the relative wetness or dryness of the denuded liver surface.

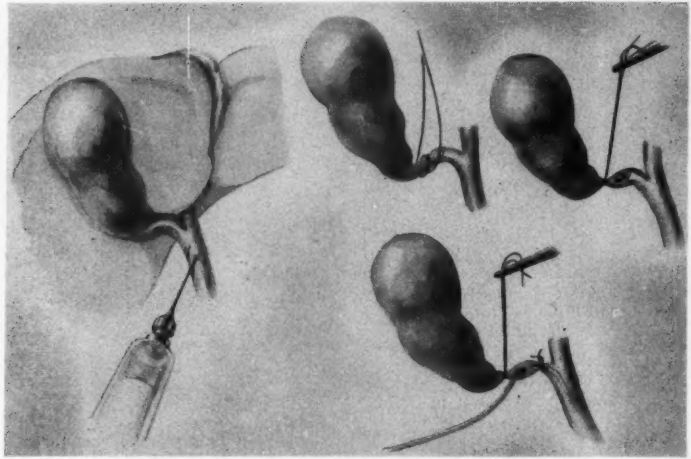


FIG. 5. Series of drawings showing preliminary procedures before common duct exploration or cholangiogram. Cholecystectomy is done *after* these two procedures. From left to right above: (1) Aspirating the common duct before incising. (2) Method of placement of temporary ligature. (3) Incision in cystic duct for cholangiogram. Drawing below shows cannula in place for operative cholangiogram.

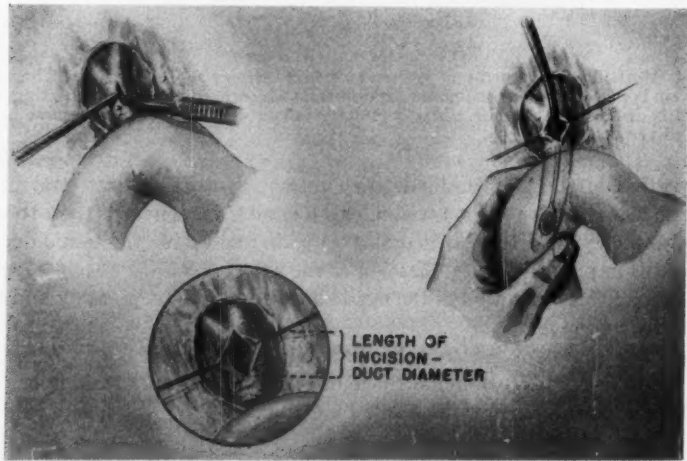


FIG. 6. Exploration of common bile duct, continued. Drawing upper left shows site of opening below cystic duct junction. Insert below shows length of incision and fine stay sutures placed. Drawing upper right shows method of palpation of retro-duodenal portion of duct after Kocher maneuver.

When it becomes necessary to remove an acutely inflamed gallbladder which is edematous and in which there is increased vascularity of all surrounding tissues, it is safer to remove the gallbladder from the fundus downward. By dissecting the fundus of the gallbladder away from its bed in the liver, the cystic



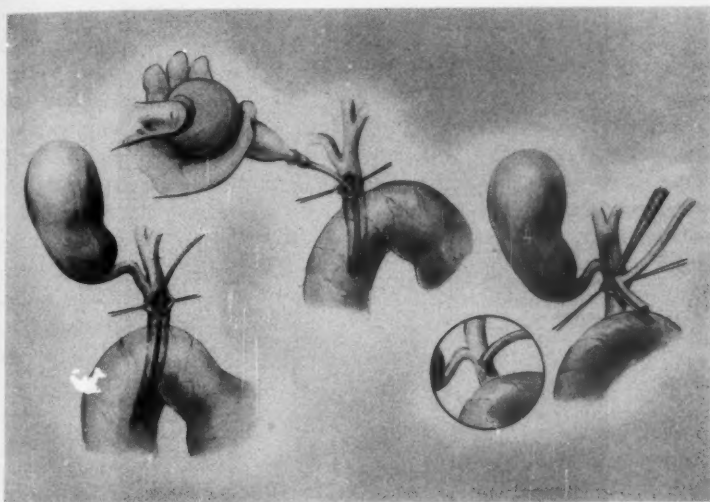


FIG. 7. Further steps for common duct exploration. Left drawing shows dilatation of sphincter. Middle figure shows irrigation. Right figure shows placement of modified T tube. Insert shows T tube sutured in place. Temporary ligature about cystic duct omitted in these drawings.

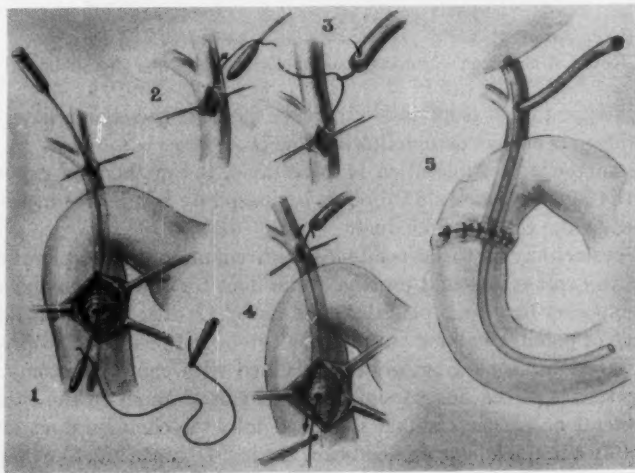


FIG. 8. Transduodenal exploration of common duct. Series of drawings show an easy method of placing long-arm T tube. (1) Silk suture tied about neck of Bakes dilator. (2) Dilator withdrawn through common duct opening. (3) Free end of silk suture tied to end of T tube and (4) Tied and T tube pulled through sphincter. (5) Closure of duodenum and common duct.

artery and duct can be straightened with enough tension to make them more easily identified and isolated. These structures are again ligated separately and in continuity before dividing. Usually there is bleeding from the liver bed during this procedure, but this can be controlled by placing a temporary pack. If ooz-

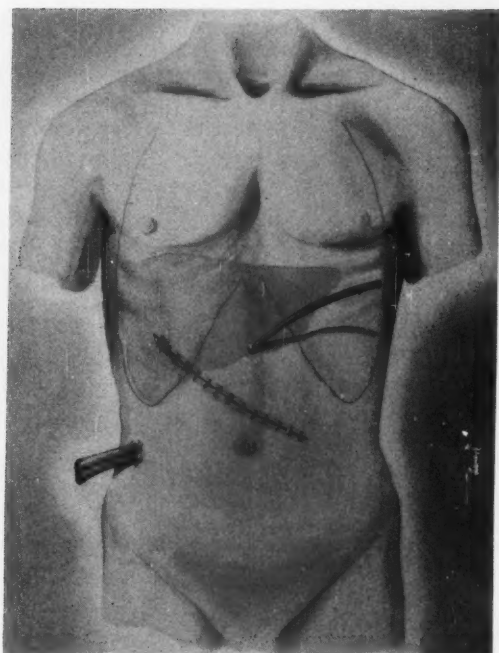


FIG. 9. Closure of abdomen. Drawing shows position of T tube and subhepatic drain

ing persists after this, it is advisable to cover the liver bed with a large gelfoam pack. Drainage is always done following this procedure.

When common duct exploration is to be done, the methods of exposure are basically the same. A safe rule to follow is to aspirate bile before incising what is identified as the common bile duct.

If cholecystectomy is to be combined with common duct exploration, it is preferable to explore first and use the cystic duct for traction on the common duct. A temporary ligature is placed around the cystic duct to prevent additional bile spillage or possible milking out of a small stone between the two procedures.

When an operative cholangiogram is planned with cholecystectomy, a temporary ligature is placed first. A small incision is made high on the cystic duct, and a ureteral or plastic cannula is passed into the common duct and made watertight by a fine silk ligature tied below the incised area (Fig. 5). A permanent ligature is placed after the cannula is withdrawn.

The first step of common bile duct exploration is incision of the duct just below the cystic duct junction. The length of the incision should be approximately equal to the diameter of the duct. On opening the duct, the bile is aspirated. Stay sutures of fine silk are placed for traction (Fig. 6). Thorough and gentle exploration is done using forceps, scoops, catheters, and silk woven Bougies, and by palpating over these instruments. Adequate dilatation of the sphincter is done

with graduated dilators, and the duct is irrigated. A split T tube is placed, and the duct is reapproximated using interrupted fine silk sutures (Fig. 7).

If either an impacted large stone or a tight stenotic sphincter are present, it becomes necessary to combine the procedure with a transduodenal exploration and sphincterotomy. If it is thought that postoperative stenosis of the sphincter may be likely, a long T tube is placed as shown (Fig. 8) and left in several months, although there may be certain disadvantages in the use of this T tube. After complete exploration, and after the T tube has been sutured in place, a drain is placed in the subhepatic area. The drain and T tube are brought out through *separate* stab wounds. With this incision, it is preferable to bring the T tube out through a midline small opening above the incision, and the drain through a lateral stab wound in the right flank, below the costal flare (Fig. 9). Care should be taken that the drain and T tube are not interlocked.

#### CONCLUSION

In conclusion, an operative technic using an oblique incision and the principle of ligation in continuity before division of the cystic duct and cystic artery has been described. It is thought that this is a safe method which minimizes operative damage during this procedure.

*Heyburn Bldg.  
Louisville, Ky.*

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## ACUTE IDIOPATHIC CHYLOPERITONEUM

THOMAS P. BUTCHER, M.D., EDWARD J. RYAN, M.D.

*Emporia, Kan.*

On Aug. 19, 1955, a 67 year old Negro man awakened at 5:00 a.m. with persistent cramp-like aching in the lower abdomen, most marked at the midline. He felt an urge to defecate, went to the stool, and had a "normal" bowel movement. The pain persisted. He became nauseated, did not vomit, but broke out in a cold sweat and had to be helped from the toilet back to bed. This "shock" picture lasted some 30 minutes. By 6:00 a.m., he was seen in the home by one of us (E. J. R.) and given an injection of penicillin, on a presumptive diagnosis of gastroenteritis. He subsequently complained of cramping substernal pain, relieved by soda. There were no urinary symptoms. He was admitted to the hospital at 9:00 a.m.

His past history included typhoid fever at 18, pneumonia on several occasions, bilateral inguinal hernia repair in 1952, and antiluetic treatment at age 40, with a negative serology thereafter.

On physical examination the temperature was 98.2°; pulse 80; respiration 16; and blood pressure 132/86. Head, neck, and chest were not unusual except for oral sepsis. The abdomen was scaphoid and some muscle guarding was evident, especially over the lower half, which was tender, especially in the midline and right lower quadrant. Rebound tenderness was noted in the same areas. The psoas sign was equivocal. No masses were felt. On rectal examination the prostate felt normal and nothing unusual was evident. Urine examination was negative except for albumin and acetone, each 1 plus, and several fine, granular casts. Hemoglobin was 86 per cent; red blood cells 4.0 million; white blood cells 8,050; segs. 87 per cent, stabs 1 per cent, eosinophils 1 per cent, and lymphocytes 11 per cent. Serum amylase was 141 mgm per cent (normal—60 to 110 mg. per cent); the Wassermann was negative. A preoperative diagnosis of acute appendicitis was made and the abdomen, via a McBurney incision, was opened 6 hours after the onset of abdominal pain.

On opening the peritoneal cavity several cubic centimeters of creamy white fluid, having the appearance and consistency of whole milk or thin cream, escaped. The wall of the cecum beneath its peritoneal coat appeared unusually white—this was noticeable to a lesser degree in other portions of the colon and small bowel. Lacteals were not unusually prominent and no mesenteric engorgement or edema was evident. An exploratory incision was made in the upper right rectus muscle. Careful examination by palpation and visualization of the stomach, duodenum (including the third portion), small and large intestines, appendix, spleen, liver, and gallbladder revealed no other abnormalities. However, the entire pancreas seemed somewhat thickened. There was no apparent abnormality in the root of the mesentery. The free white fluid was found in all portions of

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the peritoneal cavity, but no point of leakage could be seen. The foramen of Winslow was patent. Free fluid was aspirated, the appendix removed, a penrose drain placed to the right iliac fossa, and the incisions closed.

The immediate postoperative condition was good. There was some abdominal distention for 48 hours, but peristalsis remained active. There was very little drainage. The drain was removed on the sixth day, and the patient went home on the seventh day, after an uneventful convalescence. He has had no subsequent gastrointestinal symptoms to date.

#### DISCUSSION

The presence of free chyle in the peritoneal cavity is a rare condition which, in its acute form, presents the picture of a surgical condition within the abdomen. It is almost never diagnosed before operation. However, the first available report of chylous ascites which was chronic was made by Morton in 1694 in the case of a 2 year old boy. Uniquely, the diagnosis was made first on the basis of the history and physical findings and later confirmed by paracentesis. So far as we can determine, this accomplishment has not since been repeated.

Dr. William Hoffman,<sup>4</sup> of Brooklyn, who cites Morton's case, published, in March 1954, a collective review of 23 acute cases, added one of his own, and appended an extensive bibliography. We have found 8 additional cases in the literature,<sup>1, 2, 7 (2 cases), 8, 10-12</sup> bringing the number to 32. Of these 32 acute cases, an etiologic factor was apparent in 22. Obstruction of some sort accounted for 13; rupture of a chylous duct or cyst had occurred in 4; blunt trauma to the abdomen had occurred in 3; staphylococcus infection complicated 1 case; and surgery at the root of the mesentery preceded 1. A breakdown of the obstructed cases shows:

peritoneal band obstructing small bowel.....	3 cases
volvulus of small bowel.....	1 case
inguinal hernia.....	2 cases
mesenteric adenitis (1 was tubercular; perforation may have occurred here).....	2 cases
swelling above left clavicle.....	2 cases
enlarged heart pressing on thoracic duct.....	2 cases
term pregnancy.....	1 case
	<hr/>
	13 cases

In 11 of the cases (including our own) no etiologic factor was evident. The present account thus appears to be the thirty-third case of acute chyloperitoneum, and the eleventh idiopathic one, to be reported to date.

Gross<sup>3</sup> reported 5 cases of chylous mesenteric cysts in children. No mention was made of free chyle in the peritoneal cavity or of "white bowel." One died of bowel infarction due to volvulus.

*Does diet play a role?* Over one-third of the 32 cases followed a heavy meal, rich in fats. This was true in 6 of the 11 idiopathic cases, but was lacking in ours.

*Why do these patients suffer abdominal pain?* Hoffman concludes that "chyle outside of its own retaining vessels is a noxious substance" and produces peritoneal irritation. In chronic chyloperitoneum (chylo-ascites) pain is not prominent.

*Diagnosis of chyloperitoneum*, except in Morton's case, has not been made until chyle has been encountered, and even then it has not always been promptly recognized. Wyatt and Gross<sup>14</sup> did, however, call attention to a peculiar radiolucency (due to fat in the fluid) noted as outlining the liver in an infant with chylous ascites due to bowel obstruction.

It is desirable that the surgeon be familiar with the condition so that it may be recognized, evaluated, and confusion avoided. Full abdominal exploration is indicated. This should include careful examination of the mesentery and its root for tumors or cysts, and of the bowel for any form of intestinal strangulation or obstruction. Postoperative drainage was employed in at least 18 of the patients and omitted in 10. It appeared to serve little purpose. The appendix was removed in 10 without evident untoward effect.

*Prognosis in the acute cases is good.* One death<sup>4</sup> occurred in the 32 cases and was probably due to neglect (delay of 4 days; paralytic ileus, etc.). Another patient died 2 months later of miliary tuberculosis.

No case of recurrence of acute chyloperitoneum after initial recovery from such a condition was reported. On the other hand, 3 instances<sup>7, 11, 12</sup> of reoperation within a few days or weeks revealed complete absence of chyle.

*Is acute idiopathic chyloperitoneum an entity?* In each of the 11 cases so named, the etiology was unknown, abdominal pain was abrupt and severe, chyle was present beneath the serosa (white bowel) in 10 and was present as free fluid in rather large amounts in the abdominal cavity in 9. Recovery was prompt and complete in each instance except for the one fatality involving paralytic ileus.

*What is the sequence of events?* When obstruction occurs does back-pressure rupture small chylous vessels, or does chyle infiltrate beneath the peritoneum by diapedesis from the vessels, and then from the peritoneum into the free cavity by a similar process? It is obvious, from the 3 cases noted above, that free chyle in the peritoneal cavity is absorbed readily by the serosa. Is the dead white appearance of the bowel due then to extravasation from the lymphatics or to absorption of free chyle? Perhaps both processes occur. In 2 reports<sup>4</sup> noting white bowel no mention is made of free chyle; in another, free chyle is reported and nothing said about a white bowel. However, in a fourth case<sup>28</sup> where there was rupture of the cisterna chyli from which free chyle was seen to escape, the cecum was also reported as white. Did this patient initially have obstruction which caused the rupture plus extravasation beneath the peritoneum, or was the white bowel simply absorbing the free chyle? Lerrick<sup>7</sup> reported a case in which the peritoneum of the abdominal wall is noted as white. It would be of interest to observe and biopsy the parietal peritoneum of the anterior abdominal wall. "Whiteness" and microscopic chyle, if present, would tend to support absorption as the basis for its appearance. Unfortunately, we failed to make this observation, and have seen no report of it in the literature. Biopsy of any white peri-



toneum would be of interest to determine whether the chyle was within lymphatic vessels or in the interstitial tissues.

*Did our patient have acute pancreatitis* with edema and obstruction of the cisterna chyli? This was suggested by the amylase level of 141 mg per cent (on the basis of normal being 60 to 110 mg per cent) plus questionable edema of the pancreas. However, there was complete absence of symptoms suggesting pancreatitis, either before or after the acute illness, and the slightly elevated amylase may easily have been a result of this illness.

Hoffman points out that normal chyle is a specialized form of lymph which bears the products of fat digestion. Lymph resembles serum in composition, except that lymph has about half as much protein. Chyle resembles lymph, except for the added fat droplets which are demonstrable by the Sudan III stain. It contains some lymphocytes and few other cells. The fatty layer separates out on standing. Chyle is alkaline in reaction, and, according to Lampson, is bacteriostatic.

Can the remarkable fact of prompt recovery in these cases be explained? The lymphatic tissues represent the most primitive form of interstitial fluid movement. They possess better regenerative powers than, for example, the blood vascular system, and experimental work<sup>20, p. 217-27, p. 106</sup> has shown that obstruction of the thoracic duct with extravasation of chyle usually is promptly relieved by collateral lymphatic-venous anastomosis. It might be inferred that with recovery, after one insult to the thoracic duct, these anastomoses which form will protect the peritoneal cavity from subsequent such insults. The literature appears to substantiate this suggestion since reports of repeated attacks of acute chyloperitoneum are lacking. The cases of chronic chyloperitoneum, however, do not fare so well; just why is not clear, and they constitute another field for study.

Exclusive of other disease which has its own implication for morbidity and mortality, it appears that acute chyloperitoneum follows a rather characteristic pattern. An initial insult may involve trauma or obstruction, and includes possible rupture of a chylous vessel or cyst. In a definite group no etiologic factor is apparent. The pattern includes (a) the *escape of chyle* into the free peritoneal cavity and/or its appearance in abnormal amounts beneath the serosa—most often both; (b) *abdominal pain* suggesting an acute abdomen; and (c) *reconstitution of the chyle system*, reabsorption of the chyle, and recovery.

It is presumed that in the "idiopathic" cases some precipitating factor, mechanical or chemical, must exist, but so far, eludes identification. In each instance the condition was not anticipated, and in some it was not promptly recognized even at operation. Hence, reports tend to be fragmentary. It is desirable that surgeons become familiar with the subject, both in the interests of the patient and for better understanding of this unusual entity.

#### CONCLUSIONS

Report is made of a case of acute idiopathic chyloperitoneum. So far as we have been able to determine, this is the eleventh case to be reported.

This is a rare and obscure condition from which spontaneous and prompt recovery is the rule. Elective appendectomy appears justifiable. Drainage is probably unnecessary.

In every instance, however, full abdominal exploration is desirable to rule out other organic disease such as chylous cyst, mesenteric tumor, hernia, or other form of intestinal obstruction, etc.

Further observations at the operating table, including biopsies, are needed.  
*Emporia, Kan.*

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## EDITORIAL

## SURGEON, INTERNIST AND THE INTESTINAL TRACT

In no field of practice is the internist so dependent upon the help and advice of the surgeon as in treatment of diseases of the gastrointestinal tract. He must use the resources and ingenuity afforded by his skill, fortified by the laboratory and roentgenology department. With these findings in hand he must often rely upon the judgment and skill of the surgeon for adequate treatment. If he could know exactly what lesion is present anywhere in the intestinal tract, the course of therapy whether medical or surgical would be clear, if not simple.

With the perfection of x-ray and endoscopic methods the diagnosis of lesions in the esophagus can usually be clearly established. Techniques for treatment have improved markedly during recent years but still much is desired, especially in obtaining a higher rate of cure or even survival in the case of malignancy.

Upper gastrointestinal bleeding is perhaps the most unsolved of our problems. Dr. Eddie D. Palmer in attempting to define the cause of upper gastrointestinal bleeding has emphasized effectively the necessity for an accurate diagnosis before rational treatment, either medical or surgical, can be outlined. In the instance of severe upper gastrointestinal bleeding hospitalization should be effected at once. X-ray and endoscopic examinations need not be delayed to establish a correct diagnosis, and a surgical consultant should be called early rather than late, even if the entire course of treatment is medical from first to last. A safeguard is thrown about the patient's welfare by having a surgeon in attendance or on call so that surgical treatment, if necessary, should not be too long delayed.

Not all surgeons, not all internists and certainly not all surgeons and internists are in agreement as to when a gastric ulcer should be treated surgically. It would appear that the safest course to follow is one of close teamwork between the internist, roentgenologist and the surgeon and a separate consideration of each individual case upon its merit, without prejudice. It is certain with all of our diagnostic skill we are not able to differentiate accurately between the benign and malignant ulcer and herein appears to lie our greatest responsibility.

In the treatment of malignancy of the stomach, all are likely to agree that surgery is the method of choice. Even those patients whose cases appear to be so extensive as to be beyond surgical help deserve at least an exploration and, if possible, palliative surgery. How extensive should be the surgical excision of the lesion, sometimes including total gastrectomy and removal of adjacent organs, remains debatable. We who are not surgeons have often thought that a simple palliative procedure would have served the patient better than a total gastrectomy and a resection of surrounding organs, rendering the patient an invalid and miserable for the remainder of his short span of life.

Surgical treatment of duodenal ulcer and its complications undoubtedly comprises the brightest chapter in surgery of the gastrointestinal tract. Subtotal gastrectomy with its variations, depending upon the indication of each indi-

vidual case, has been attended with a higher degree of success and has caused the internist to more generally accept surgery as solution for the resistant or complicated ulcer. Particularly is this true in partially obstructive lesions or intractable ulcers without obstruction or perforation.

Regional enteritis appears to be without a satisfactory solution either from a medical or a surgical standpoint. This undoubtedly stems from its unknown etiology and from the great variation in manifestations of the disease. It appears now that resection of the lesion is to be desired when feasible rather than short circuiting operations. The results of surgical treatment are far from satisfactory and it may be added that in the well established case of regional enteritis medical treatment is not satisfactory.

Uncertainty as to the etiology of ulcerative colitis and the great variation of its manifestations in individual patients also contributes to the disappointing management of this disease, either medical or surgical. The internist may be criticized for the long medical management in the hope of eventual response to conservative means. The difference of opinion among surgeons as to the criteria for surgery and the type of surgery to be done, however, does not lead the internist to hope for successful surgical treatment when his efforts have failed. Dr. Harvey B. Stone in an editorial in the *Journal of Chronic Disease* of June 6, 1955 outlined what we believe to be a reasonable and conservative approach of a master surgeon to this problem. Total colectomy, like total gastrectomy, is a severely disabling procedure at the very best and should be deferred as long as such a delay can be regarded as consistent with reasonable safety.

Consistent progress is being made regarding the etiology of many of the obscure diseases affecting the intestinal tract. New diagnostic technics and the improvement of old ones are leading us to a more definitive diagnosis in a larger percentage of instances. The internist has at hand antibiotics, steroids and a better understanding of physiology and pathology as a basis for the improvement of his methods of therapy. Perfection of new surgical technics and improved experience in the use of older ones are gradually rendering more of these diseases amenable to cure by surgery. Enlightened teamwork is more necessary now than ever before.

SAM A. OVERSTREET

714 Heyburn Bldg.  
Louisville 2, Ky.

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## BOOK REVIEWS

*The editors of THE AMERICAN SURGEON will at all times welcome new books in the field of surgery and will acknowledge their receipt in these pages. The editors do not, however, agree to review all books that have been submitted without solicitation.*

**Urology and Industry.** BY LEONARD PAUL WERSHUB, M.D., Charles C Thomas, Springfield, Illinois, Publisher.

This informative and concise book deals with the medical-legal problems arising in industry, as related to urologic cases.

To appreciate the current position of employer and employee, when illness or injury arises or has allegedly arisen from employment, there is an interesting history of the evolution of our present day Workman's Compensation Acts, and industrial medicine in general.

Following this historic introduction, there is a very informative section about pertinent legal and medical evaluation of causal relation.

One hundred of the author's cases, encompassing clinical history and urologic management of each case, and comments as to the medical-legal implication of the various problems encountered, are presented.

This book should enable any physician or urologist, having clinical contact with industrial patients, and the legal profession to gain further insight into the medical aspects of this problem. The book is timely and fills a very definite need in our armamentarium.

JOHN F. HOGAN, JR., M.D.

**Hypophysectomy.** BY O. H. PEARSON, M.D., F.A.C.P., Charles C Thomas, Springfield, Illinois, Publisher.

Hypophysectomy is a monograph of the American Lectures in Tumors which presents the experiences of neurosurgeons, radiologists, endocrinologists and physiologists, with the clinical aspects of pituitary obliteration in the human being as an adjunct to the treatment of malignancy and diabetes mellitus.

The statistics of the surgeons indicate that complete removal of the hypophysis is difficult to accomplish and carries considerable mortality and morbidity in the hands of those only occasionally performing the operation.

The radiologists state that their technics either fall short of complete destruction of the gland or when this is accomplished, the destruction of adjacent structures is excessive.

The results obtained by hypophysectomy in carcinoma of the breast certainly warrants continued clinical application, while its use in other malignancies and diabetes mellitus would seem unjustified.

The discussion of surgical technic, postoperative care, and criteria for patient selection will benefit those considering to add hypophysectomy to their armamentarium.

This is a forthright discussion of a procedure only recently applied to the treatment of man, which may also academically open doors to the mysteries of endocrine influence upon man in sickness and in health.

J. SHARRETT, M.D.

**Tumor Surgery of the Head and Neck.** BY ROBERT S. POLLACK M.D., F.A.C.S., Clinical Instructor in Surgery, Stanford University School of Medicine; Clinical Instructor in Surgery (Oncology), University of California School of Medicine. Lea and Febiger, Philadelphia, 1957.

This small volume is a brief and concise review of the most important surgical procedures for head and neck tumors. The author presupposes a good background in general surgery. The first five chapters are very brief and deal with diagnosis and diagnostic procedures, isotopes, and the fifth chapter is entitled "Surgery or Irradiation."

The sixth chapter described briefly preoperative concepts and the seventh deals with the surgical technics. Here the author presents with a minimum of description but with amply illustrated step by step diagrams, the technics for tracheostomy, lower lip cancers, hemimandible resection, lower and upper intraoral cancer, the maxillary antrum, major salivary glands, thyroid gland, and larynx.

The important question of radical neck dissections was not touched upon since the author thought that he could add little to the large number of descriptive articles available on the subject. The last two chapters treat the basic concepts of postoperative care, and the management of recurrent cancer.

Those general surgeons not doing head and neck tumor surgery routinely can find within the covers of this little book a handy review of the general principles necessary for these operations.

ARTHUR G. SIWINSKI, M.D.



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